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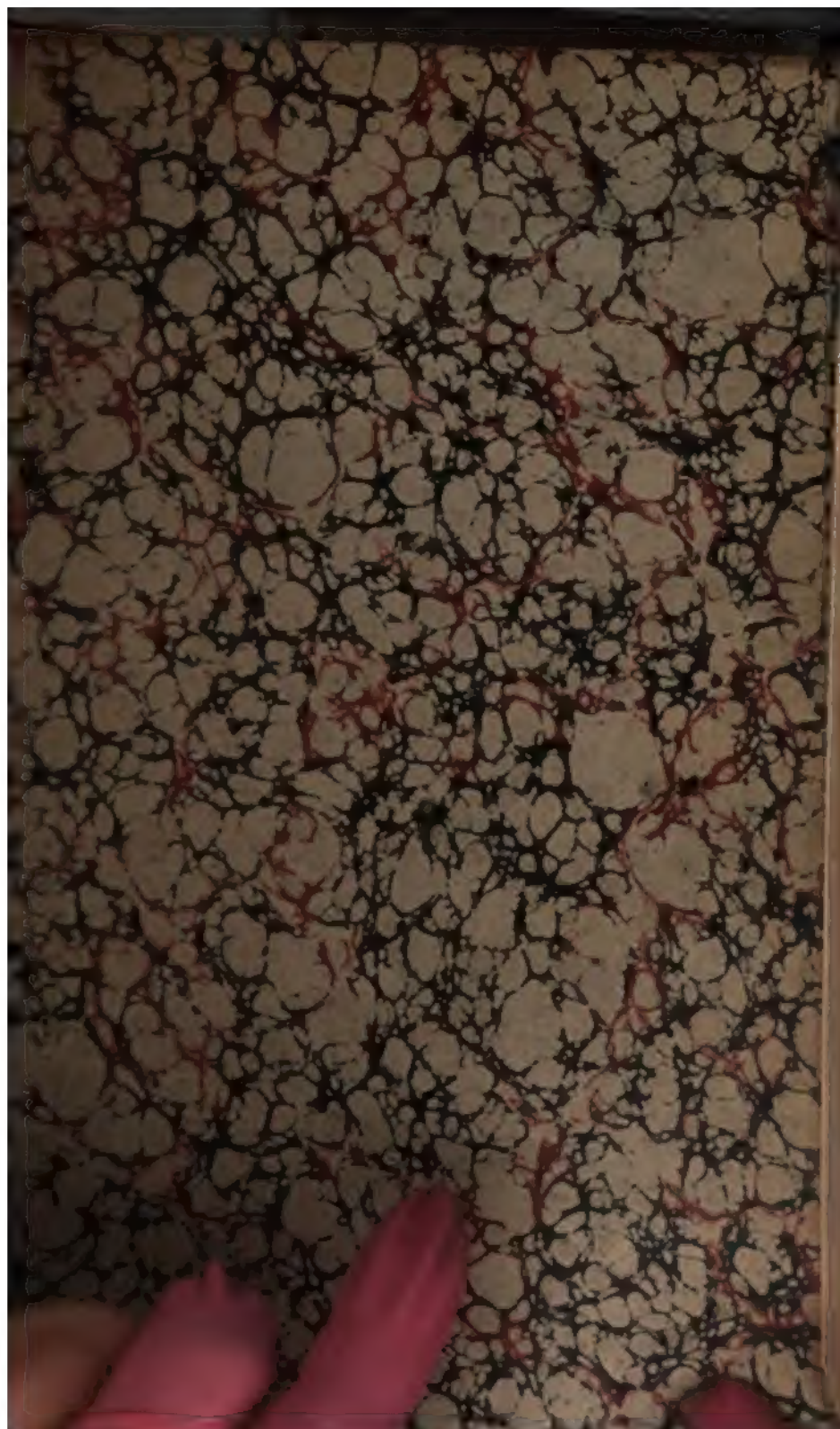
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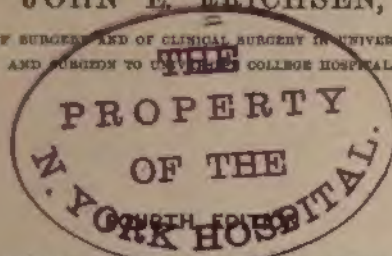
*" They be the best Chirurgions which being learned incline to the traditions
of experience, or being empirics incline to the methods of learning."*

BACON on Learning.

THE
SCIENCE AND ART
OF
SURGERY.

BEING
A TREATISE ON SURGICAL INJURIES, DISEASES, AND
OPERATIONS.

BY
JOHN E. ERICHSEN,
PROFESSOR OF SURGERY AND OF CLINICAL SURGERY IN UNIVERSITY COLLEGE,
AND SURGEON TO UNIVERSITY COLLEGE HOSPITAL.



ENLARGED AND CAREFULLY REVISED.

ILLUSTRATED BY FIVE HUNDRED AND SEVENTEEN ENGRAVINGS ON WOOD.



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1864.

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1864

PREFACE

TO THE FOURTH EDITION.

SINCE the first publication of this work, nearly eleven years ago, it has passed through three large editions in this country and two in America. It has also been translated into German by Dr. Oscar Thamhayn, of Halle; and is now in the hands of a French editor.

The favourable reception which it has thus met with, at home and abroad, has stimulated me to spare no exertion in my endeavour to make the present edition worthy of the continued confidence of the Profession, as a Guide to the Practitioner, and a Text-Book for the Student in Surgery. With this view, every page has been carefully revised. Some chapters have been in a great measure re-written; new woodcuts have been introduced; and the text has been considerably enlarged. The additions thus made to the work have not been confined to any particular parts of it, but have been widely distributed through the various subjects of which it treats. They are almost entirely of a practical character, embodying the results of my extended experience, and containing an account of the most important recent advances in Surgery.

SURGERY is that Department of the Healing Art which treats upon and includes the consideration of—

1. The Injuries—from whatever cause arising—to which the human frame is liable.
2. *Malformations and Deformities, Congenital and Acquired.*
3. *All External Diseases; and all those Diseases that*

specially or primarily affect the Organs of Sense, of Locomotion and of Reproduction.

4. All those Diseases that require Manual, Mechanical, Operative means for their cure or relief; and the nature and application of such means.

In considering so wide a range of subjects as this, the general arrangement adopted in previous Editions of this Work has been preserved in the present one. The Book is divided into three parts. The First Division, under the head of FIRST PRINCIPLE contains general observations on Operative Surgery, and more especially on Amputations; together with a condensed view of the Nature and Treatment of Inflammation and its Special Form. The Second Division comprises the consideration of SURGICAL INJURIES; and the Third that of SURGICAL DISEASES.

In considering both Injuries and Diseases, it has appeared to me to be more consistent with a natural arrangement to treat first, of those common to all parts of the Body, as Wounds, Abscesses, Ulcers, &c.; secondly, of the Injuries and Diseases of Special Tissues, as of the Osseous Tissue—Fractures and Necrosis; of the Vascular Tissue—Wounds of Blood-Vessels and Aneurisms; and, thirdly, of the Injuries and Diseases of Regions.

The more Special Operations I have considered as part of the Treatment of the different Injuries and Diseases for which they are required; a plan which, I think, is more practically useful than to describe them apart as a separate subject. I have limited the consideration of Affections of the Eyes to Injuries of those organs; their Diseases being a special subject of such magnitude, as to require for its proper description far more space than could be allotted to it in this work. For a similar reason, a limited notice only has been taken of Diseases and Injuries of the Ears.

Throughout the work, it has been my object to place before the practitioner and student the Art and Science of Surgery, not as consisting merely in the observation of such Diseases, Injuries, and Malformations as belong to the classes mentioned above, or in the dexterous application of manual or operative means for their

nial; but as demanding an exercise of general Medical knowledge, and a thorough acquaintance with all those conditions, whether intrinsic to the patient or surrounding him, that favour or prevent his restoration. The remarks in the commencing paragraphs of the first Chapter will, it is trusted, sufficiently indicate to the student what is required of him in this respect, in order that he may become a successful practitioner.

In every instance, I have endeavoured to give as plain and full a description of Symptoms, Pathology, Diagnosis, and Treatment, as the importance of each demands and the present state of our knowledge permits. With regard to Diagnosis, I may specially remark that, as accuracy in this branch is an all-important requisite for success in Treatment, I have, in each case, not merely described the signs and symptoms by which the injury or disease under consideration may be recognised, but have been careful—even at the risk of repetition—to point out the several conditions with which it may be confounded, and the means of distinguishing it from each of them.

In discussing the numerous topics that are embraced in a systematic Treatise on Surgery such as this, I have endeavoured, so far as lies within its scope, and without entering into anything like an historical account, to ascribe to whomsoever it may be due the merit of improvements in Practice, or of discoveries in Pathology. In some cases, I may perhaps accidentally have omitted doing so; and in other instances, where the observation has become as it were the established and common property of the Profession, I may purposely have avoided encumbering the text with names and references. In order to remedy this deficiency to some extent, I would refer the reader to the more special Treatises on the subject-matter of the different chapters. Thus I would particularly direct his attention to the admirable and philosophic Lectures on Pathology by Mr. Paget, to which I have been much indebted in preparing the chapters on Inflammation and on Tumours; to the works of Sir B. Brodie on Diseases of the Joints and of the Urinary Organs; to the Treatises of Stanley on the Bones, of Lawrence on Hernia, of Fergusson on

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CHAPTER V.—SECONDARY FORMS OF INFLAMMATION.

EFFUSIVE INFLAMMATION Nature of Effusions.— ADHESIVE INFLAMMATION —Definition—Characters of Lymph—After-Changes—Absorption—Development—Degeneration— SUPPURATIVE INFLAMMATION —Characters of Pus—Diagnosis—Symptoms—Hectic—Circumstances Influencing Tendency to Suppuration—Treatment— ULCERATIVE INFLAMMATION —Definition—Nature of the Ulcerative Process—Causes—Forms of Commencement—Stages—Granulation—Cicatrisation—Diagnosis of Ulcer—Treatment— GANEROUS INFLAMMATION —Causes—Symptoms—Arrest—Treatment	81—100
---	--------

DIVISION SECOND.

SURGICAL INJURIES.

CHAPTER VI.—EFFECTS OF INJURY.

CONSTITUTIONAL EFFECTS —Shock—Remote Effects—Treatment— TRAUMATIC DELIRIUM .— LOCAL EFFECTS	101—104
--	---------

CHAPTER VII.—INJURIES OF SOFT PARTS.

CONTUSIONS —Causes—Degrees—Diagnosis—Treatment— STRANGULATION OF PARTS .— WOUNDS —How classified.— INCISED WOUNDS —Symptoms—Modes of Union—Treatment— CONTUSED AND LACERATED WOUNDS —Sloughing—Traumatic Gangrene—Treatment—Indications for Amputation.— BURN—BURN —Treatment	105—121
---	---------

CHAPTER VIII.—GUNSHOT-WOUNDS.

GUNSHOT-WOUNDS IN GENERAL —Circumstances Affecting Character—Nature and Force of Projectile—Direction—Apertures of Entry and Exit—Symptoms—Treatment—Hemorrhage—Extraction of Foreign Bodies—Treatment of Wound—Cases Requiring Amputation.— GUNSHOT-WOUNDS OF SPECIAL BONES AND JOINTS	122—136
---	---------

CHAPTER IX.—PUNCTURED AND POISONED WOUNDS.

PUNCTURED WOUNDS —Treatment.— POISONED WOUNDS —Varieties of— STINGS .— SNAKE-BITES —Effects of Snake-Poison—Treatment.— BITES OF RABID ANIMALS —Hydrophobia—Symptoms—Prognosis—Pathology—Treatment.— WOUNDS WITH INOCULATION OF DECOMPOSING ANIMAL MATTER —Causes—Symptoms—Treatment	136—145
--	---------

CHAPTER X.—EFFECTS OF HEAT AND COLD.

BURNS AND SCALDS —Local and Constitutional Effects—Prognosis—Mode of Death from Burns—Treatment—Prevention and Removal of Contraction—Warty Cicatrices—Amputation.— FROST-BITE —Local Influence of Cold—Constitutional Effects—Treatment	145—153
--	---------

CHAPTER XI.—INJURIES OF BLOOD-VESSELS.

INJURIES OF VEINS —Venous Hemorrhage—Diffuse Phlebitis.— INJURIES OF ARTERIES —Contusion—Rupture and Laceration—Wounds, Non penetrating and Penetrating— HEMORRHAGE FROM WOUNDED VESSELS —Local Signs—Distinctive Characters of Arterial and Venous—Extravasation—Constitutional Effects—General Treatment—Transfusion of Blood	154—158
--	---------

CHAPTER XII.—ARREST OF ARTERIAL HEMORRHAGE.

NATURAL ARREST OF HEMORRHAGE—History of Investigations—Temporary Means—Changes in the Blood and in the Heart's Action—Retraction and Contraction of the Artery—Formation of Congulum—Permanent Closure—Adhesion—Contraction—Arrest of Hemorrhage from Punctured Arteries.—SURGICAL TREATMENT—Temporary Means—Compression of Artery—Tourniquet—Permanent Means—Cold—Styptics—Cauterisation—Pressure—Tension—Acupressure—Ligature—History—Principles—Application—Effects—Collateral Circulation.—ACCIDENTS AFTER LIGATURE—Secondary Hemorrhage—Gangrene 158—185

CHAPTER XIII.—TRAUMATIC ANEURISM AND ARTERIO-VEINous WOUNDS.

TRAUMATIC ANEURISM—Diffused—Circumscribed.—ARTERIO-VEINous WOUNDS—Aneurismal Varix—Varicose Aneurism 186—191

CHAPTER XIV.—WOUNDS OF SPECIAL ARTERIES.

ARTERIES OF HEAD AND NECK—Carotid Artery—Aneurismal Varix of Internal Jugular Vein—Traumatic Aneurism of Temporal Artery—Deep Arteries of Face—ARTERIES OF UPPER LIMB—Subclavian—Aneurismal Varix of Subclavian Vein—Axillary—Open Wounds—Traumatic Aneurism—Brachial Artery—Wounds—Traumatic Aneurism—Varicose Aneurism—Aneurismal Varix—Arteries of the Forearm and Palm—Traumatic Aneurism of Radial and Ulnar Arteries—Wounds of Palmar Arteries—Circumscribed Traumatic Aneurism in the Palm.—ARTERIES OF LOWER LIMB—Femoral Artery and its Branches—Diffused Traumatic Aneurism—Arteries of the Leg and Foot—Wounds and Traumatic Aneurisms—Traumatic Aneurism of Gluteal Artery 192—200

CHAPTER XV.—ESTRANCE OF AIR INTO VEINS.

AIR IN VEINS—Results of Experiments on Animals—Spontaneous Entry in Man—Local Phenomena—Constitutional Effects—Cause—Preventive Treatment—Curative Treatment—Indications to be followed 201—206

CHAPTER XVI.—INJURIES OF NERVES, MUSCLES, AND TENDONS.

INJURIES OF NERVES—Contusion—Puncture—Division—INJURIES OF MUSCLES AND TENDONS—Sprains or Strains—Rupture—Union—Treatment 207—209

CHAPTER XVII.—INJURIES OF BONES AND JOINTS.

INJURIES OF BONES—Contusion—Bending.—INJURIES OF JOINTS—Contusions—Sprains—Treatment—Wounds of Joints—Symptoms and Effects—Traumatic Arthritis—Treatment—WOUNDS OF INDIVIDUAL JOINTS—Hip and Shoulder—Knee—Ankle—Elbow—Wrist 209—214

CHAPTER XVIII.—FRACTURE.

CAUSES OF FRACTURE—Varieties—Nature—Direction—Signs—Union—In Simple Fracture—In Compound Fracture—Treatment of Simple Fracture—Reduction—Prevention of Return of Displacement—Bandages—Splints—Stretched Bandage—Plaster of Paris Bandage—Accidents during Treatment—Swelling—Extravasation of Blood—Edema and Gangrene—Pulmonary and Cerebral Congestion—Complicated Fractures—Treatment—Compound Fracture—Removal of the Lamb—Rebreaking and Resetting Bones—Delayed Union—Ununited Fracture and False Joint 214—247

CHAPTER XIX.—SPECIAL FRACTURES.

FRACTURES OF THE FACE AND TRUNK—Nasal Bones—Malar and Upper Jaw Bones—Lower Jaw—Hyoid Bone—Ribs and Costal Cartilages—Sternum.—
FRACTURES OF THE UPPER EXTREMITY—Clavicle—Scapula—Acromion—
Humerus—Forearm—Metacarpus and Fingers. FRACTURES OF THE LOWER
EXTREMITY—Pelvis—Sacrum—Coccyx—Thigh-bone—Patella—Tibia and
Fibula—Foot 248—284

CHAPTER XX.—DISLOCATIONS.

DISLOCATIONS—Causes—Signs—Effects—Treatment—Mechanical Contrivances
—Extension—Dislocation of old Standing—Treatment—Dangers of Attempts
at Reduction—Compound Dislocations—Treatment—Complications—Spontaneous
Dislocations—Congenital Dislocation 285—295

CHAPTER XXI.—SPECIAL DISLOCATIONS.

LOWER JAW—Causes—Bilateral—Unilateral—Reduction—Congenital Dislocation.—CLAVICLE—Sternal End—Acromial End—Simultaneous of Both Ends.
—SCAPULA—Humerus—Varieties—Subcoracoid—Subclavicular—Subspino-
us—Subglenoid—Partial Causes—Relative Frequency—Diagnosis—
Treatment—Compound—Congenital—Unreduced—Accidents in attempted
Reduction.—ELBOW JOINT—Both Bones—Ulna—Radius—Complications—
Treatment—Compound—Old Unreduced Dislocations—Wrist—Backwards—
Forwards—Diagnosis—Compound—Congenital—SINGLE CARPAL BONES
—Os Magnum—Isidorm—Semilunar—METACARPAL BONES.—METACARPO-
PHALANGEAL JOINTS—Thumb—PHALANGES OF FINGERS. PELVIS—Pubic
Symphysis—Sacro-iliac Articulation—Coccyx.—HIP—Varieties—Ilio-sciatic
—Into Obturator Foramen—On Pubic Bone—Other Femur—Reduction of
Old Dislocations—Complication with Fracture—Simultaneous.—PATELLA.—
KNEE—Varieties—Subluxation—Complications—Compound—Dislocation—
Head of Fibula.—ANKLE—Varieties—Compound.—ANTRAGALUS—Varieties
—Treatment—Compound.—TARSAL BONES—Calcaneum and Scaphoid—
Calcaneum—Scaphoid and Cuboid—Great Cuneiform—METATARSAL BONES
295—330

CHAPTER XXII.—INJURIES OF THE HEAD.

CEREBRAL DISTURBANCE—Concussion—Compression—Cerebral Irritation—
Secondary Results of Injury—Traumatic Encephalitis—Intracranial Suppu-
ration—Treatment of Cerebral Injuries and their Effects.—INJURIES OF THE
SCALP—Contusions—Cephaloematoma—Wounds—Contusion of Cranial
Bones.—FRACTURES OF THE SKULL—Causes and Varieties—Fracture by
Contre-coup—Simple Fracture—Fractures of the Base of the Skull—Signs
Hæmorrhage—Discharge of Watery Fluid—Depressed Fractures—Varieties
—Symptoms—Wounds of the Dura Mater—Treatment of Depressed Fracture
—Wounds of the Brain and its Membranes—Causes—Symptoms—Diabetes
—Injuries of Cranial Nerves—Fungus or Hernia Cerebri—Extravasation of
Blood within the Skull—Symptoms—Diagnosis—Operation of Trephining
330—362

CHAPTER XXIII.—INJURIES OF THE SPINE.

CONCUSSION OF THE SPINAL CORD—Causes—Symptoms—Pathological Results—
Treatment—WOUNDS OF THE CORD—Symptoms—In Lumbar and Lower
Dorsal Region—In Middle Dorsal Region—In Lower Cervical Region—
Above Phrenic Nerve—SPRAINS—Symptoms—Treatment.—FRACTURE—
Signs and Symptoms—Treatment—DISLOCATIONS—Of Atlas from Occipital
Bone—Of Axis from Atlas—Of Lower Cervical Vertebrae—Of Transverse
Processes of Cervical Vertebrae—Of Dorsal Vertebrae 362—370

CHAPTER XXIV.—INJURIES OF THE FACE AND ADJACENT PARTS.

FACE—Cuts—Treatment—Lips—Parotid Duct—Salivary Fistula—Foreign Bodies in Nose.—EARS—Wounds—Foreign Bodies.—OBLIT.—Dangers attending Injury to.—EYE—Contusion—Contusion with Rupture—Treatment—Wounds, Penetrating and Non-Penetrating—Treatment.—MOUTH.—TONGUE.—PALATE AND PHARYNX 370—374

CHAPTER XXV.—INJURIES OF THE THROAT.

LARYNX AND TRACHEA—Dislocation and Fracture of Larynx—Wounds of Throat—Not extending into Air-passages—Impheating Air-passages—Aerial Fistula—Foreign Bodies in Air-passages—Symptoms—Treatment—Scald of Mouth and Throat—Treatment.—ASPHYXIA—Surgical Treatment—From Drowning—Artificial Respiration—Secondary—From Noxious Gases—From Hanging.—PHARYNX AND ESOPHAGUS—Wounds—Foreign Bodies—Pharyngotomy and Esophagotomy 375—390

CHAPTER XXVI.—INJURIES OF THE CHEST.

INJURIES OF THE LUNG—Rupture—Wound—Symptoms—Complications—Hemorrhage—Hemothorax—Emphysema—Pneumothorax—Pneumonia—Empyema—Prognosis—Treatment—Pneumatocele.—WOUNDS OF THE HEART AND LARGE VESSELS—Injury of the Pericardium—Wounds of the Heart—Ruptures of the Heart from External Violence—Wounds of Aorta and Vena Cava 390—398

CHAPTER XXVII.—INJURIES OF THE ABDOMEN AND PELVIS.

ABDOMEN AND ABDOMINAL VISCERA—Contusion of the Abdominal Walls—Ruder Accidents—Rupture of Abdominal Viscera—Emphysema of Abdominal Wall—Wounds of Diaphragm—Wounds of Abdominal Wall—Non-Penetrating—Penetrating—Without Wound or Protrusion of Viscera—With Wound or Protrusion Of Intestine—Treatment—Traumatic Peritonitis—Treatment.—INJURIES OF PELVIC VISCERA—Rupture of Bladder—Foreign Bodies in Bladder—Rupture of Ureter—Wounds of Organs of Generation—Wound of Urethra—Laceration of Urethra—Foreign Bodies in Vagina or Rectum—Laceration of the Perineum—Treatment 399—413

DIVISION THIRD.

SURGICAL DISEASES.

CHAPTER XXVIII.—ABSCESS.

ABSCESS defined—Varieties—Acute or Phlegmonous—Chronic—Cold—Diffuse—Tympatric or Emphysematous—Situation and Size—Effects—Diagnosis—Prognosis—Treatment—Preventive—Of Acute Abscess—Of Chronic Abscess—Incisions—Tapping—Potassa Fusa—Drainage-tubes—SINUS AND FISTULA—Causes and Structure—Treatment 414—423

CHAPTER XXIX.—ULCERS.

FORMS OF ULCER—Healthy or Purulent—Weak—Indolent—Irritable—Inflamed—Stecching—Farcose—Hemorrhagic—On Mucous Membranes 423—426

CHAPTER XXX.—MORTIFICATION OR GANGRENE.

GANGRENE defined—Local Signs—Symptoms—Prognosis—Causes—Four Classes—From Arrest of Circulation—Strangulation—Arterial Obstruction—Obstructive Arteritis—Embolism—Senile—From Venous Obstruction—Treatment—Of Spontaneous Gangrene—Of Senile Gangrene—Amputation 420—436

CHAPTER XXXI.—GANGRENOUS DISEASES.

BED-SORES—Treatment.—SLOUGHING PHAGEDÆNA, OR HOSPITAL GANGRENE—Local Signs—Constitutional Symptoms—Causes—Treatment.—GANGRENOUS STOMATITIS, OR CANCRUM ORIS—Signs—Treatment.—BOILS—Causes—Treatment.—CARBUNCLE—Signs—Diagnosis—Prognosis—Treatment 436—444

CHAPTER XXXII.—ERYSIPELAS.

ERYSIPELAS—Characters—Causes—Hygienic Influences—States of Blood—Season—Contagion.—EXTERNAL ERYSIPELAS—Cutaneous—Cellulo-Cutaneous—Cellular—Diagnosis—Prognosis—Treatment—Of Cutaneous Erysipelas—Of Cellulo-Cutaneous Erysipelas—Of Cellular Erysipelas—Special Forms—In Newly-born Infants—Orbit—Head—Scrotum—Pudenda—Whitlow.—INTERNAL ERYSIPELAS—Erysipelas of Mucous Membranes—Fauces—Larynx—Erysipelas of Serous Membranes—Arachnoid—Pentoneum . 444—461

CHAPTER XXXIII.—PURULENT INFECTION OR PYEMIA.

PYEMIA defined—Causes—Symptoms—Formation of Purulent Deposits—Diagnosis—Pathology—Treatment 461—467

CHAPTER XXXIV.—TUMOURS.

DEFINITION AND CLASSIFICATION—Non-malignant—Malignant—Semi-malignant.—ENCYSTED TUMOURS—From Simple Distension of Duct or Cyst—Newly-formed Cysts, Simple or Serous, and Compound or Proliferous—Pilocystic Tumours—Sanguineous Cyst or Hæmatoma.—TUMOURS FROM INCREASE OF NORMAL TISSUE—Warts and Condylomata—Cheloid—Wens—Polypi—Hypertrophy of Glands—Fatty or Adipose Tumours—Lipoma—Fibro-cellular Tumours.—TUMOURS FROM GROWTH OF STRUCTURES IDENTICAL WITH OR RESEMBLING NORMAL TISSUES IN ABNORMAL SITUATIONS—Fibrous Tumours—Semi-malignant Tumours—Malignant Fibrous—Fibro-plastic or Myeloid—Recurring Fibroid—Enchondroma.—CANCER—Varieties—Characters—Microscopic Structure—Progress—Scirrhus—Encephaloid—Colloid—Gelatinous or Areolar—Melanosis or Black Cancer—Diagnosis of Cancer—Causes—Treatment—Constitutional—Local—Palliative Means—Curative Treatment—Caustics—Compression—Excision—Question of Operating—Cases not admitting Operation—Doubtful Cases—Cases proper for Operation.—EPITHELIOMA—Characters—Diagnosis—Treatment—Excision—Ligature—Ecraseur—Caustics.—EXCISION OF TUMOURS . . . 468—504

CHAPTER XXXV.—SCROFULA OR STRUMA.

SCROFULA defined—Scrofulous Diathesis and Temperament—Strumous Inflammation Of Skin—Mucous Membranes—Bones and Joints—Glands—Tubercle—Causes of Scrofula—Treatment—Operations in Scrofulous Disease 505—512

CHAPTER XXXVI.—SYPHILIS.

SYPHILIS defined.—PRIMARY SYPHILIS.—CHANCRE—Specific Nature—Origin and Progress—Varieties—Simple or Soft—Indurated or True Hunterian—Phagedæmic Chancre—Sloughing Chancre or Gangrenous Phage-

1222—Situations of Chancre—Diagnosis—Treatment of Primary Syphilis— Local—Constitutional—Mercurial and Non-mercurial Plans—Administration of Mercury—Treatment of Special Forms of Chancre.—CONSERVATIVE SYMPTOMS—Indurated Cicatrices—Treatment—Bubo—Primary Bubo— Crawling Bubo—Treatment—Venereal Warts.—CONSTITUTIONAL OR SECOND- ARY SYPHILIS—Transmissibility—Progress—Phenomena—Circumstances influencing Occurrence—Treatment—Use of Mercury—Local Secondary Affections—Syphilitic Skin-Diseases—Warts, Excrescences, and Vegetations —Syphilis of Mucous Membranes—Syphilitic Iritis—Periosteum and Bones —Nails—Syphilitic Necrosis and Caries—Syphilitic Disease of Testicle— Syphilitic Ovarius—Syphilis of Muscles and Tendons. INFANTILE SYPHI- LIS—Nature—Mode of Communication—Symptoms—Influence on Teeth— Treatment	513—550
---	---------

CHAPTER XXXVII.—SURGICAL AFFECTIONS OF THE SKIN AND ITS APPENDAGES.

DISEASES OF THE APPENDAGES OF THE SKIN—Warts—Corns—Diseases of the Nails—Onychia—Ingrowing of the Nails—Hypertrophy of Toe-Nail.— MALIGNANT TUMOURS AND ULCERS OF THE SKIN—Cheloid and Fibro- Vascular Tumours—Lupus—Varieties—Lupus Non-exedens—Lupoid Ulcer —Lupus Exedens—Microscopic Structure—Diagnosis—Treatment—Cancer of the Skin—Scirrhous Wart—Infiltrated Cancer—Cancerous Ulcers— Treatment	550—558
---	---------

CHAPTER XXXVIII.—DISEASES OF THE LYMPHATICS AND THEIR GLANDS.

INFLAMMATION OF THE LYMPHATICS, LYMPHATITIS, OR ANGIOLEUCITIS— Symptoms—Results—Diagnosis—Causes—Treatment.—INFLAMMATION OF LYMPHATIC GLANDS OR ADENITIS—Varieties—Strumous Enlargement of Glands—Treatment—Other Diseases of Glands	559—562
---	---------

CHAPTER XXXIX.—DISEASES OF VEINS.

PHLEBITIS—Pathology—Varieties—Adhesive Phlebitis—Suppurative Phlebitis —Diffuse Phlebitis.—VARIX—Definition—Appearance—Locality—Causes —Structure—Treatment—Obiteration of Varicose Veins	562—569
---	---------

CHAPTER XL.—DISEASES OF ARTERIES.

ARTERITIS—Causes—Forms—Adhesive Arteritis—Diffuse Arteritis—Secondary Effects—Narrowing of Vessel—Symptoms—Spontaneous Gangrene—Treat- ment.—STRUCTURAL DISEASES OF ARTERIES—Plastic Deposits—Fatty and Granular Degeneration—Atheroma—Calcification—Forms of Deposit, Lamellar, Annular, and Tubular—Causes of Morbid Changes—Local Effects—Ulceration—Rupture—Contraction—Treatment	569—578
--	---------

CHAPTER XLI.—ANEURISM.

ANEURISM defined—Causes—Classification—Fusiform or Tubular Aneurism— Sacculated Aneurism—True—False—Dissecting Aneurism—Formation of Aneurism—Structure—Pressure—Effects—Number—Duration—Symptoms —Of External Circumscribed Aneurism—Of Diffuse Aneurism—Diagnosis— Terminations—Spontaneous Cure—Causes of Death from Aneurism—Treat- ment—Constitutional—Valsalva's Method.—SURGICAL TREATMENT—Modes
--

of Treating External Aneurism—Ligature—Various Modes of Applying—Ligature on both sides of Sac—Hunterian Operation—Effects—Distal Ligature—Indications and Contraindications for Ligature—Accidents after—Secondary Hemorrhage—Recurring Pulsation—Secondary Aneurism—Suppuration and Sloughing of Sac—Gangrene—Compression by Instruments—Principle—Circumstances influencing Success—Application of Compressor—Effects—Applicability—Flexion—Digital Compression—Manipulation—Galvano-puncture—Injection with Perchloride of Iron.—ARTERIO-VEINUS ANEURISMS	579—615
---	---------

CHAPTER XLII.—ANEURISMS OF THE THORAX, HEAD AND NECK, AND UPPER EXTREMITY.

THORACIC AORTA—Symptoms—Auscultatory Signs—Pressure effects—Pulsation and Tumour.—INNOMINATE ARTERY—Symptoms—Pressure effects—Prognosis—Treatment—Ligature of Subclavian only—Of Carotid only—Of Subclavian and Carotid.—CAROTID ARTERY—Aneurismal Varix of Carotid Artery and Jugular Vein—Spontaneous Aneurism of Carotid—Symptoms—Diagnosis—Treatment—Ligature of Carotid—Effects on Brain and Lungs—Distal Ligature.—INTERNAL CAROTID ARTERY—Extracranial Aneurism—Treatment.—INTRACRANIAL ANEURISM Vessels Affected Causes—Pathology—Pressure effects—Symptoms—Causes of Death—Treatment.—INTRAORBITAL ANEURISM—Causes—Symptoms—Treatment.—SUBCLAVIAN ARTERY—Symptoms—Diagnosis—Results—Treatment—Ligature of the Brachio-cephalic Artery—Ligature of Subclavian on Tracheal Side—Compression of Artery on Distal Side—Ligature beyond the Scaleni—Amputation and Distal Ligature.—AXILLARY ARTERY—Symptoms—Diagnosis—Treatment—Ligature of the Subclavian—Accidents following Operation—Thoracic Inflammations—Suppuration of the Sac—Secondary Hemorrhage—Gangrene—Treatment of Inflamed Axillary Aneurism threatening Suppuration—Ligature of Axillary Artery.—ARM, FOREARM, AND HAND—Treatment—Ligature of the Brachial Artery—Ligature of Radial and Ulnar Arteries	616—662
---	---------

CHAPTER XLIII.—ANEURISMS OF THE LOWER EXTREMITY.

INGUINAL ANEURISM—Symptoms—Diagnosis—Treatment—Ligature of External Iliac Artery—Ligature of Common Iliac—Ligature of Aorta—Aneurism of the Internal Iliac and its Branches—Ligature of Internal Iliac.—FEMORAL AND POPLITEAL ANEURISMS—Aneurism of Deep Femoral Artery—Aneurism of the Superficial Femoral and Popliteal Arteries—Symptoms—Diagnosis—Treatment—Ligature of Common Femoral—Of Superficial Femoral—Results—Accidents attending Operation—Wound of Femoral Vein—Secondary Hemorrhage—Gangrene—Return of Pulsation—Secondary Aneurism—Double Popliteal Aneurism—Diffuse Popliteal Aneurism—Amputation for Diffuse Aneurism—Aneurism of the Tibial Arteries—Ligature of Posterior Tibial—Of Anterior Tibial—Of Arteria Dorsalis Pedis	663—680
---	---------

CHAPTER XLIV.—ANEURISM BY ANASTOMOSIS; AND NÆVUS.

ANEURISM BY ANASTOMOSIS—Nature—Diagnosis—Treatment.—NÆVUS—Capillary—Venous—Structure—Treatment—Operations on—Ligature of.—NÆVI IN SPECIAL SITUATIONS—Scalp—Fontanelle—Face—Eyelids—Nose—Cheeks—Lips—Tongue—Penis—Vulva and Pudendum—Extremities, Neck, and Trunk—Nævoid Lipoma.—HEMORRHAGIC DIATHESIS—Causes—Treatment	680—692
--	---------

CHAPTER XLV.—DISEASES OF THE NERVOUS SYSTEM.

STROKES—Symptoms—Treatment. **NEURALGIA**—Symptoms—Situations—Causes—Diagnosis—Treatment. **NEUROMA**—Structure—Traumatic Neuroma—Treatment. **TETANUS**—Nature—Causes of Traumatic Tetanus—Period of Occurrence—Forms—Symptoms—Pathology—Treatment 692—702

CHAPTER XLVI.—DISEASES OF BONE.

PERIOSTITIS—Symptoms—Treatment. **OSTEITIS**—Symptoms—Treatment.—**SUPPURATION OF BONE**—Acute Suppuration Osteo-pyclitis and Osteomyelitis—Treatment—Chronic Suppuration—Symptoms—Treatment.—**CARCINOMA**—Definition—Structure—Symptoms—Treatment—Operations on Carcinoma Bone—Necrosis—Nature—Causes—Characters—Symptoms—Separation of the Dead Bone—Reparative Process—Treatment—Removal of the Sequestrum—Amputation—Resection—Necrosis of the Sternum, Scapula, and Pelvis—Cranial Bones—Lower Jaw—Patella—Ribs . 703—720

CHAPTER XLVII.—STRUCTURAL CHANGES IN BONE.

HYPERTROPHY—**ATROPHY**.—**RICKETS**—Nature and Symptoms—Treatment.—**MOLLITIES AND FRAGILITAS OSSUM**—Nature—Cause—Seat of the Disease—State of Urine—Symptoms—Diagnosis—Treatment.—**TUBERCLE OF BONE**—Characters and Effects—Pathology—Treatment.—**TUMORS OF BONE**—**EXOSTOSIS**—Varieties—Symptoms—Treatment—**Osteoma**—**Enchondroma**—**Cystic Tumours**—Structure—Treatment—**Hydatids**—**Osteo-Cancer**—**Central Cancer**—**Peripheral Cancer**—Symptoms—Diagnosis—Treatment—**Sarcomatous Tumours**—Treatment—**Osteo-Aneurism**—Characters—Situation—Symptoms—Diagnosis—Treatment . 720—735

CHAPTER XLVIII.—DISEASES OF JOINTS.

SYNOVITIS—Causes—Pathology—Symptoms—Acute Synovitis—Chronic Synovitis—**Hydrarthrosis**—Terminations—Treatment.—**ARTHRITIS**—Simple Acute and Chronic Arthritis—Situations—Causes—Symptoms—Diagnosis—Pathology—Nature of Changes in Cartilage—Destruction of Cartilage from Synovial Disease—From Disease of Bone—By Inflammation or Ulceration—Repair—Treatment—Chronic Rheumatic Arthritis—Nature—Occurrence in Hip—Pathological Changes—Diagnosis—Treatment—Chronic Rheumatic Arthritis of Lower Jaw Of Shoulder—Chronic Strumous Arthritis or White Swelling—Symptoms—Pathological Changes—Treatment.—**ANCHYLOSIS OR STIFF JOINT**—Incomplete or Fibro-cellular Anchylosis—Complete or Osseous Anchylosis—Treatment—**LOOSE CARTILAGES IN JOINTS**—Warty State of Synovial Membrane—Characters of Loose Cartilages—Symptoms—Treatment.—**NEURALGIA OF JOINTS**—Symptoms—Treatment . 735—756

CHAPTER XLIX.—EXCISION OF JOINTS AND BONES.

HISTORY—Indications for Excision—Conditions of Success—Repair after Excision—Instruments—Operation.—**EXCISION OF SPECIAL JOINTS AND BONES**—Shoulder-Joint—Excision for Disease—For Compound and Comminuted Fracture—Scapula—Clavicle—Elbow Joint—Cases demanding Excision—Operation—Results—Ulna or Radius—Wrist—Operation—Conservative Surgery of the Hand—Excision of Fingers and Metacarpal Bones—Conservative Surgery of the Lower Extremity—Excision of Hip-Joint—Knee—Operation—Results—Bones of the Leg—Conservative Surgery of the Foot—Conditions demanding Excision—Tarsal Bones—*Os Calcis*—Astragalus—Cuboid Bone—Scaphoid—Cuneiform Bones—Malleolus—Metatarsal Bones—**TUMORS**—**AMPUTATION IN JOINT-DISEASES** . 756—785

CHAPTER L.—DISEASES OF THE SPINE.

SPINA BIFIDA—Characters—Prognosis—Treatment.—CARIES OF THE VERTEBRUM—Pathological Changes—Symptoms—Formation of Abscess—Diagnosis—Prognosis—Treatment.—DISEASE OF THE ATLAS, AXIS, AND OCCIPUT—Treatment 785—792

CHAPTER LL.—DISEASE OF THE SACRO-ILIAC JOINT.

SACRO-ILIAC DISEASE—Nature—Pathology—Symptoms—Prognosis—Diagnosis—Treatment 792—797

CHAPTER LII.—DISEASE OF THE HIP-JOINT.

HIP-JOINT DISEASE—Characters—Pathological Conditions—Pain—Attitude—Suppuration—Sinuses—Dislocation—Anchylitis.—ARTHRITIC COXALGIA—Symptoms—Results—ACETABULAR COXALGIA—Symptoms.—FEMORAL COXALGIA—Symptoms—Prognosis of Hip-Joint Disease—Life—Utility of the Limb—Diagnosis of Coxalgia—Treatment.—EXCISION OF THE HEAD OF THE THIGH-BONE AND OF THE HIP-JOINT—Cases requiring the Operation—Removal of Diseased Acetabulum and Pelvic Bones—Method of Operating—Results—Caries of the Great Trochanter 798—814

CHAPTER LIII.—DISEASES OF SYNOVIAL MEMBRANES AND OF MUSCLES.

DISEASES OF BURSE—Situations in which Bursæ exist—Morbid Alterations—Diagnosis—Treatment—Diseases of the Bursa Patellæ—Inflammation—Suppuration—Disease of the Patella—Sloughing of the Bursa Patellæ—Enlargements—Housemaid's Knee—Treatment—Chronic Enlargement—Solid Tumours—Treatment—Bunion—Treatment.—DISEASES OF SHEATHS OF TENDONS—Ganglion—Simple Ganglion—Compound Ganglion—Treatment—Ganglion in the Hand and Foot—Tenosynovitis—Treatment.—DISEASES OF MUSCLES—Inflammatory Affections—Syphilitic Disease—Tumours of Muscle—Treatment 814—823

CHAPTER LIV.—DEFORMITIES.

LATERAL CURVATURE OF THE SPINE—Nature—Mechanism—Cyphosis and Lordosis—Causes—Signs—Treatment—Of Lateral Curvature—Of Posterior Excavation—Of Posterior Incurvation.—CONTRACTION AND RETRACTION OF MUSCLES—Causes—Treatment—Tenotomy—Repair in Divided Tendons.—DEFORMITIES AFFECTING THE FACE AND NECK—Squint—Causes—Treatment—Wry Neck—Causes—Nature—Treatment.—DEFORMITIES OF THE ARM AND HAND—Contraction of the Arm—Straight Anchylitis—Contraction of Muscles of Forearm—Club-hand—Contraction of the Fingers—Remarkable Congenital Deformity of Fingers.—DEFORMITIES OF LEG AND FOOT—Knock-knee—Treatment—Contraction of the Knee-joint—Varieties—Cause—Hysterial Contraction—Treatment—Contraction from Inflammation—Chronic Contraction—Contraction from Ligamentous Consolidation—Treatment—Contraction of Hamstrings—Division of the Tendons—Contraction with Lateral Displacement—Treatment—Ossæous Anchylitis of Knee—Club foot—Varieties—Pathological Changes—Talipes Equinus—Treatment—Talipes Calcaneus—Treatment—Talipes Varus—Treatment—Talipes Valgus—Treatment—Talipes Calcaneo-valgus—Contraction of the Plantar Fascia—Contraction of One Toe—Weak Ankles 823—848

CHAPTER LV.—DISEASES OF THE HEAD AND NECK.

SCALP AND SKULL—Fungus of the Dura Mater—Nature—Symptoms—Treatment—Fungus of the Skull—Hernia Cerebri—Encephalocele.—EYE AND ITS

APPENDAGES—Encysted Tumour of the Eyelids—Treatment—Puncture of the Lacrymal Sac—Extirpation of the Lacrymal Gland—Extirpation of the Eyelid—EAR—Otitis—Otorrhoea—External Ear—Hypertrophy—Gouty Concretions—Fibrous Tumours—Concretions in the Meatus—Polypus—The Hearing of the Eustachian Tube—Deafness—DISEASES OF THE NOSE AND MOUTH—Epistaxis—Treatment—Plugging the Nares—Chronic Thickening of the Schneiderian Membrane—Treatment—Abscess—Ulcers and Fissures—Necrosis—Lupus—Lupus and Epithelial Cancer—Polypus—Varieties—Mucous Polypus—Symptoms—Diagnosis—Treatment—Fibrous Tumour—Malignant Tumour—Cancers—Diseases of Frontal Sinuses—Tumours and Ulcers of Cheeks—Salivary Fistula—Lips—Congenital Malformations—Hypertrophy—Ulceration—Tumours—Encysted—Erectile—Malignant Diseases—Epithelioma—Removal—PAROTID GLAND—Parotitis—Treatment—Tumours—Diagnosis—Treatment—Excision of the Parotid Gland.—TUMOURS OF THE NECK—Fatty and other Tumours—Hydrocele—Enlarged Lymphatic Glands.—BLOOD-VESSELS—Simple Hypertrophy of Thyroid Body—Cystic Bronchocele—Pulsating Bronchocele—Treatment 843—867

CHAPTER LVI.—DISEASES OF THE JAWS AND THEIR APPENDAGES.

DISEASES OF THE GUMS AND ALVEOLAR PROCESSES—Abscess—Ulceration—Epyulis—Simple Epyulis—Treatment—Malignant Epyulis—Necrosis—Treatment—DISEASES OF THE ANTRUM AND UPPER JAW—Dropsy of the Antrum—Treatment—Suppuration—Treatment—Tumours—Varieties—Symptoms and Signs—Diagnosis—Treatment—Excision of the Upper Jaw—DISEASES OF THE LOWER JAW—Tumours—Varieties—Diagnosis—Treatment—Excision of the Lower Jaw 867—877

CHAPTER LVII.—DISEASES OF THE TONGUE AND THROAT.

TONGUE—Tongue-tie—Prolapsus—Glossitis—Abscess—Morbid Changes of Epithelium—Leucorrhoea—Glossitis—Fissures—Syphilitic Tubercle—Cancerous and Cancerous Diseases—Nature—Diagnosis—Treatment—Ligature—Ecraseur—Excised and other Tumours—Ranula—Varieties—Treatment—VELUM AND TONSILS—Elongation of the Uvula—Tonsillitis—Treatment—Hypertrophy of the Tonsils—Excision of Tonsils.—DISEASES OF THE PHARYNX—Inflammation—Abscess—Treatment—Tumours—Varieties.—STRUCTURE OF THE PHARYNX—Conditions Producing Dysphagia without Stricture—Forms of Stricture—Hysterical—Fibrous—Carcinomatous—Causes—Treatment—Gastrostomy.—DISEASES OF THE LARYNX—Laryngitis—Varieties—Acute Laryngitis—Symptoms—Treatment—Oedematous Laryngitis—Symptoms—Diagnosis—Treatment—Chronic Laryngitis—Nature—Symptoms—Treatment—Alleged Introduction of Instruments through the Glottis—Removal of Chronic Laryngitis—Plastic Deposits—Ulceration—Necrosis of the Larynx—Laryngeal Pthiasis—Abscess—Nervous Affections of the Larynx—Spasmodic Croup—Spasm of the Larynx in Adults—Tumours or Polypus 878—903

CHAPTER LVIII.—PLASTIC SURGERY OF THE FACE AND MOUTH.

PLASTIC OR REPARATIVE SURGERY—Definition—Methods of Operating—Conditions of Success—PLASTIC SURGERY OF THE EYELIDS—Blepharoplasty—Operation for Symblepharon—Epi-anthis—Ptosis—Entropion—Ectropion.—PLASTIC SURGERY OF THE NOSE—Restoration of Columella—Of Ala—Of Nose—Tubercular Operation—Indian Operation—Fistulous Openings through Nasal Bone—Operation for Depressed Nose.—PLASTIC SURGERY OF THE LIP—Harelip—Forms—Age for Operation—Operation for Single Harelip—Operation for Double Harelip—Treatment by Simple Suture—

Congenital Fissure of the Cheeks—Cheiloplasty—Buchanan's Operation for Restoring Lower Lip.—PLASTIC SURGERY OF THE PALATE—Age for Operation—Stapyloraphy—Ferguson's Operation—Uranoplasty—Perforations of the Hard Palate	904—923
---	---------

CHAPTER LIX.—OPERATIONS ON THE AIR-PASSAGES AND CHEST,

LARYNGOTOMY AND TRACHEOTOMY—Conditions requiring Operation—Opening the Windpipe in Croup and Diphtheria—Necessity for Promptitude—Operations—Laryngotomy—Tracheotomy—Difficulties—Exposing the Trachea—Hemorrhage—Opening the Trachea—Introduction of Tube—Tracheotomy in Children—Comparison of Laryngotomy and Tracheotomy—Trachea-Tubes.—TAPPING THE CHEST In Empyema and Hydrothorax—In Hydrops Pericardii—Drainage-Tubes	923—935
---	---------

CHAPTER LX.—DISEASES OF THE BREAST.

DISEASES OF THE BREAST—Ages at which they occur.—ANOMALIES OF DEVELOPMENT—Absence of Breast—Supernumerary Breasts and Nipples.—NEURALGIA—Symptoms—Diagnosis—Treatment. HYPERTROPHY Simple—Treatment—Lobular. ABNORMAL CONDITIONS OF THE LACTEAL SECRETION—Absence—Excessive Flow—Lacteal Tumour.—INFLAMMATION OF THE BREAST—Varieties Of Nipple and Areola Treatment—Abscess of Areola—Milk-Abscess—In Subcutaneous Cellular Tissue—Between Breast and Pectoral Muscle Of Mammary Gland—Treatment Chronic Abscess Diffused—Treatment Encysted Diagnosis—Treatment.—TUMOURS OF THE BREAST.—NON-MALIGNANT TUMOURS—Varieties—Chronic Mammary or Adenoid Tumour Treatment—Painful Mammary Tumour Treatment—Cystic Tumour—Unilocular Cyst—Compound Cysts—Cystic Sarcoma—Treatment—Various rare Tumours—Recurrent Fibrous Tumour—Scrofulous Tumour—Hyalids—Tumours containing Fœtal Remains.—MALIGNANT TUMOURS—Varieties—Scirrhus—Symptoms—Implication of Skin Pain—Retraction of Nipple—Implication of Axillary Glands—Duration of Disease—Structure of Scirrhus—Encephaloid—Colloid—Causes of Cancer of Breast—Sex—Age—Injuries—Inflammation—Diagnosis—Treatment—Compression—Caustics—Operation Question of Relapse Prolongation of Life by Operation—Selection and Rejection of Cases for Excision—Return after Operation—Amputation of the Breast.—DISEASES OF THE BREAST AND AXILLARY GLAND IN THE MALE—Varieties—Scirrhus Tumours in Axilla—Chronic Strumous Disease of Axillary Glands	935—904
---	---------

CHAPTER LXI.—HERNIA.

HERNIA defined—Structure—Sac—Neck—Body—Contents—Enterocœle—Epiplœcœle—Entero Epiplœcœle—Adhesions—Fluid—Hydrocœle of Hernial Sac—Foreign Bodies in Sac—Signs of Hernia—Intestinal Hernia—Omental Hernia—Cœcal Hernia—Cystocœle—Exciting Causes—Age—Sex—Occupation—Conditions presented by Hernia.—REDUCIBLE HERNIA—Definition—Application of Truss Radical Cure of Hernia—Wutzer's Operation—Wood's Operation.—IRREDUCIBLE HERNIA—Causes—Symptoms—Treatment—Inflamed Irreducible Hernia—Incarcerated Hernia.—STRANGULATED HERNIA—Definition—Mechanism of Strangulation—Seat of Stricture—Local Effects of Strangulation—Symptoms—Local Constitutional—Modifications of Symptoms—Diagnosis—Treatment—Taxis—Auxiliary Measures—Persistence of Symptoms after Reduction—Treatment.—OPERATION FOR STRANGULATED HERNIA—Operation in which the Sac is Opened—Exposure of the Sac—Opening the Sac—Division of the Stricture—Reduction—After-

Treatment—Accidents and Modifications of the Operation—Peritonitis—Management of Congested Intestine—Of Tightly Constricted Intestine—Of Congested Intestine—Of Adhesions—Of Omentum—Wounds of the Intestine—Wounds of Arteries—Sloughing of the Sac—Artificial Anus and Faecal Fistula—Operation without Opening the Sac—Reduction in Mass—Hydrocele of the Hernial Sac 965—1001

CHAPTER LXII.—SPECIAL HERNIÆ.

ISCHEMIC HERNIA—Varieties—Oblique—Coverings and Relations—Direct—Coverings and Relations—Incomplete or Interstitial—Double—Symptoms—Diagnosis—Treatment—Operation—Seat of Stricture—In Tunica Vaginalis—Symptoms—Complication with Undescended Testis—Treatment—Encysted Hernia in Tunica Vaginalis.—FEMORAL HERNIA—Course—Relations—Complications—Symptoms—Diagnosis—Treatment—Operation—UMBILICAL HERNIA—In Children—In Adults—Treatment—Operation—OTHER VARIETIES OF HERNIA—Ventral—Obturator—Perineal—Vaginal—Podendal—Sclerotic—Diaphragmatic 1001—1021

CHAPTER LXIII.—INTESTINAL OBSTRUCTION.

ACUTE OBSTRUCTION—Causes—Symptoms.—CHRONIC OBSTRUCTION—Symptoms—Diagnosis of Causes of Obstruction—Duration of Constipation—Seat—Varying—Diagnosis of Seat of Obstruction.—TREATMENT OF ACUTE OBSTRUCTION—Inflation of Intestine—Gastrotomy—Treatment of Chronic Obstruction—Formation of Artificial Anus—Amussat's Operation—Statistics 1021—1032

CHAPTER LXIV.—TAPPING THE ABDOMEN. TUMOURS OF THE GROIN.

TAPPING THE ABDOMEN. TUMOURS IN THE GROIN—Varieties—Diagnosis—Pulsating—Non Pulsating—Reducible—Irrducible—Fluid Tumours—Solid Tumours—Treatment 1032—1033

CHAPTER LXV.—DISEASES OF THE LARGE INTESTINE AND ANUS.

CONGENITAL MALFORMATIONS—Narrowing and Partial Closure of Anus—Complete Closure of Anus—Occlusion of Rectum above Anus by Membranous Septum—Complete Absence of Anus—Closure of Anus with Absence of Rectum—Formation of Artificial Anus—Iliac Incision—Lumbar Incision—External Incision—Opening of Rectum into other Canals.—STRICTURE—Simple or Fibrous—Symptoms—Progress—Treatment—Cancer and Malignant Stricture—Symptoms—Treatment—Cancer of Anus—Fibrophlegm—Tumour of Rectum—Polypi of Rectum.—RECTAL FISTULÆ—Recto-vaginal Fistula—Entero-vaginal Fistula—Recto-vaginal Fistula—Treatment—ULCER AND FISSURE OF THE ANUS—Spasmodic Anal—Symptoms of Ulcer or Fissure—Causes—Treatment—Spasmodic Contraction of Sphincter Ani—Abscess and FISTULA—Acute Ischi-rectal Abscess—Chronic Abscess—Treatment—Fistula in Ano—Extent—Varieties—Complete—Incomplete or Blind—Treatment—Division.—HEMORRHOIDS OR PILES—Varieties—Predisposing Causes—Exciting Causes—Structure—External Piles—Symptoms—Internal Piles—Longitudinal—Globular—Symptoms—Hemorrhage—Complications—Terminations—Subsidence—Ulceration—Suppuration—Sphacelus—Diagnosis—Of Hemorrhoidal Tumours—Of Hemorrhoidal Flux—Treatment—Constitutional—Local—Painful—Ligature—Caustics—Pruritus Ani.—PROLAPUS ANI—Causes—Diagnosis—Treatment—Palliative—Curative—Ligature 1034—1064

CHAPTER LXVI.—URINARY CALCULUS.

CALCULOUS DEPOSITS AND DIATHESSES—Lithic Acid Diathesis—Sediments—Calculus—Treatment—Oxalic—Calculi—Treatment—Phosphatic—Varieties of Phosphates—Calculi—Treatment—Xanthine—Carbonate of Lime—Cystine—STONE IN THE BLADDER—Structure of Calculi—Origin—Renal Calculi—Descent—Treatment—Vesical Calculi—Number—Spontaneous Fracture—Physical Characters—Causes—Symptoms—Physical Diagnosis of Stone—Sounding Bladder—Changes induced by Calculus. LITHOTOMY—Instruments—Preparation of Patient—Lateral Operation—Stages—Position of Blade—Incision of Prostate—Extraction of Stone—After Treatment—Lateral Lithotomy in Children—Difficulties during Lithotomy—In entering Bladder—In Stizing and Extracting the Stone—From Position of Stone—From Fracture of Stone—From Rickets—From Shape and Size of Stone—Removal of Large Stone—Difficulty from Fracture of Stone—Accidents—Hemorrhage—Wound of Bulb—Missing the Urethra—Wound of Rectum—Wound of Posterior Part of Bladder—Difficulties in Children—Sources of Danger and Causes of Death—Statistics of Mortality—Influence of Age—Of Shock—Hemorrhage—Cystitis—Diffuse Pelvic Cellulitis—Peritonitis—Sloughing—Median Lithotomy—History—Operation—Comparison between Median and Lateral Lithotomy—General Ease and Simplicity—Hemorrhage—Wound of Bulb—Wound of Rectum—Treatment of Prostate—Seizure and Removal of Stone—Indications for Median Lithotomy—Bilateral Operation—Combined Median and Bilateral Operation—High or Suprapubic Operation—LITHOTRITY—History—Instruments—Preparation of Patient—Anesthetics—Operation—Introduction of Lithotrite—Seizure of Stone—Breaking Stone—Accidents in Lithotritry—Impaction of Fragments in Urethra—Chronic Enlargement of Prostate—Dangers in Lithotritry—Cystitis—Atony of Bladder—Irritation of Kidneys—Constitutional Disturbance—COMPARISON BETWEEN LITHOTOMY AND LITHOTRITY—Statistics—Circumstances determining Selection—Age—Size and Character of Stone—Condition of Urinary Organs—Chance of Operation of Lithotomy—Recurrence of Calculus after Operation—Treatment—URETHRAL CALCULUS—Symptoms—Treatment.—PROSTATIC CALCULUS—Characters—Symptoms—Treatment.—CALCULUS IN THE FEMALE—Statistics—Symptoms—Removal—Lithectomy—Simple Dilatation—Dilatation with Incision—Lithotomy—Suprapubic—Vaginal—Lithotritry	1064—1131
---	-----------

CHAPTER LXVII.—DISEASES OF THE BLADDER.

CONGENITAL MALFORMATION—Extroversion.—CYSTITIS—Acute—Termination—Treatment—Chronic Cystitis—Irritable Bladder—Vesical Catarrh—Anatomical Changes—Causes of Irritability—Diagnosis—Treatment—Irritable Bladder in Children—In Women.—TUMORS OF THE BLADDER—Polypus—CANCER—HEMATURIA—Sources—Kidneys—Bladder—Prostate—Urethra—Treatment—ATONY OF THE BLADDER—Retention of Urine—Symptoms—Results—Treatment—Incontinence of Urine—Causes—Treatment—Hysterical Retention and Incontinence—Painful Conditions of the Bladder	1132—1142
---	-----------

CHAPTER LXVIII.—DISEASES OF THE PROSTATE.

PROSTATITIS—Symptoms—Treatment—Prostatic Abscess—Retention of Urine.—CHRONIC ENLARGEMENT OF THE PROSTATE—Characters—Mechanical Effects—Symptoms—Retention of Urine—Treatment—Prostatic Catarrh—Puncture of Bladder above Pubes—Puncture above Rectum—Tunneling the Prostate—Malignant Disease of the Prostate.—PROSTATITIS	1142—1151
--	-----------

CHAPTER LXIX.—DISEASES OF THE URETHRA.

URETHRITIS—Symptoms Treatment Urethral Abscess—Perineal Abscess.—	
GONORRHEA—Cause—Character Symptoms Three Stages Treatment	
Complications—Chordee—Irritable Bladder—Retention of Urine—Urethral	
Hæmorrhage—Sequestræ—Gonorrhœal Orchitis—Conjunctivitis Scleratitis	
Inflammation of the Nose Rheumatism—Cutaneous Eruptions—Gonor-	
rhœa in the Female.—STRUCTURE OF THE URETHRA—Varieties—Spasmodic	
Stricture—Symptoms—Treatment—Congestive Stricture—Causes—Sym-	
ptoms Treatment—Organic Stricture—Seat—Characters—Mechanical	
Results—Symptoms—Examination of Urethra—Treatment—Dilatation—In-	
trojection of Catheters—Accidents Attending—Hæmorrhage—False Passages	
—Fistulae—Forcible Expansion or Rupture—Sliding Tubes—Expansion by	
NEW Mechanism By Wedge—Division of Stricture—Internal Urethro-	
tomv—EXTERNAL Urethrotomy—Operation for Permeable Stricture—Perineal	
Puncture—Results—Comparison of Methods of Treatment—Impermeable	
Stricture—Operation.—COMPLICATIONS AND RESULTS OF STRICTURE—	
Retention of Urine—Treatment—Forcible Catheterism—Opening Urethra	
by Anal Stricture Puncture of Bladder through Rectum—Puncture above	
Pelvis—Extravasation of Urine Local Effects—Constitutional Symp-	
ptoms—Treatment Urinary Abscess—Symptoms—Treatment—Urinary	
Fistula Treatment—Urethroplasty—URINARY VAGINAL FISTULE—Varie-	
ties—Urethro-Vaginal—Veno-Vaginal—Results Treatment—Sua's and	
HARRISON'S Operations.—TUMOURS OF URETHRA—Treatment—Excision—	
Legation—Cauterisation	1152—1192

CHAPTER LXX.—DISEASES OF THE PENIS AND SCROTUM.

DISEASES OF THE PENIS—Hypospadias—Epispadias—Phimosis Treatment—	
Circumcision—Paraphimosis—Treatment—For Congenital Phimosis—For	
Disease of the Prepuce—Balanitis—Posthitis—Herpes of Glans and	
Prepuce Hypertrophy of Prepuce—Warts Scirrhus and Epithelioma—	
Amputations of Penis—Nævi and other Tumours.—DISEASES OF THE SCRO-	
TUM—Inflammatory Edema—Hypertrophy—Elephantiasis—Chimney-	
sweeper's Cancer	1193—1200

CHAPTER LXXI.—DISEASES OF THE TESTIS AND CORD.

MALFORMATION OF THE TESTIS—NEURALGIA OF THE TESTIS—Treatment—IN-	
FLAMMATION OF THE TESTIS—Orchitis—Epididymitis—Seat—Symptoms—	
Salmon's Orchitis Treatment Strapping the Testis Abscess—Inflamma-	
tion of Undescended Testis.—HYDROCELE AND HEMATOCELE—Hydrocele of	
Tunica Vaginalis—Congenital Hydrocele—Symptoms Treatment—Tapping	
Insertion of Linc's Seton—Encysted Hydrocele—Hydrocele of the Cord—	
Dilated Hydrocele of Cord Hematocele—Characters—Treatment Hæma-	
tocele of the Cord VARICOCELE Causes Symptoms Treatment—Radical	
CURE TUMOURS OF THE TESTIS Simple Sarcocœle—Tuberculous Sarcocœ-	
le Septate Sarcocœle—Cystic Sarcocœle—Cysts containing Coloured	
Matter Cancer of the Testis—Symptoms Treatment—CASTRATION—	
URGENT DIAGNOSIS OF SCROTAL TUMOURS—Reddish Tumours—Irreduci-	
ble Tumours—IMPOTENCE AND SPERMATORRHEA—True Spermatorrhœa—	
Spasmodic Spermatorrhœa—Impotence—Asperma	1200—1226

CHAPTER LXXII.—DISEASES OF FEMALE GENITAL ORGANS.

INTRODUCTION OF INSTRUMENTS Speculum Vaginale Female Catheter Dia-	
GNOSIS OF THE EXTERNAL ORGANS AND VAGINA Hypertrophy of Labia	

—Condylomata—Cystic Tumours—Imperforate Vagina—Absence of Uterus and Ovaries—Hypertrophy of Clitoris—Removal of Clitoris—Vaginal Tumours—Prolapsus of Vagina—Rectocele—Cystocele—Uterine Discharges—Uterine Displacements—Vaginal Discharges—Tumours of Uterus—Polypi—Cauliflower Excrescence—Cancer.—OVARIAN TUMOURS AND DROPSY—Diagnosis—Treatment—Medical Means—Tapping—Injection of Iodine—Ovariectomy—Statistics—Operation	1226—1238
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INDEX	1239
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DIVISION FIRST.

FIRST PRINCIPLES.

CHAPTER I.

GENERAL CONSIDERATIONS ON OPERATIONS.

MANUAL dexterity is necessarily of the first advantage to a surgeon, and he should diligently endeavour to acquire the art of using his instruments with neatness, with rapidity, and with certainty; but manual dexterity must not be mistaken for professional skill; and, desirable as it doubtless may be to be able to remove a nub, or to cut out a stone, in so many wounds; important, in a word, as it is to become a dexterous operator, it is of still far greater importance to become a successful Surgeon. The object of every operation is the removal of disease that either threatens life, or interferes with the comfort and utility of existence; and the more certainly a surgeon can accomplish this object, the better will he do his duty to his patients, and the more successful will he be in his practice. Success then, as the result of an operation, whether that result be the preservation of life or the removal of a source of discomfort, is the thing to aim at. To this, dexterity and rapidity in operating are in a high degree conducive; but there are various other considerations equally or still more necessary, the solution of which can only be afforded by an intimate general acquaintance with the Science of Surgery and of Medicine. The Diagnosis of the nature of the local disease, and of the extent of its connections, has to be made; lurking visceral affections must be detected and, if possible, removed. The Constitution of the patient must be prepared; the best time for the performance of the operation seized; and, after its completion, the general health must be attended to in such a way as shall best carry the patient through the difficulties he has to encounter, and any sequelæ or complications that arise must be met by, and must be subjected to, appropriate treatment. These, as well as the simple performance of the operation, are the duties of the operator; and on the manner in which these are performed, as much as, or even perhaps more than on the mere manual dexterity displayed in the operation itself, will the fate of the patient depend. It is well known that the result of operations differs much in the practice of different surgeons of acknowledged dexterity; and this variation in the proportionate number of recoveries cannot be accounted for by any difference in the degree of manual skill displayed in the operation itself, but must rather be sought in the

greater attention that is paid by some surgeons to the constitutional treatment of their patients before and after the operation, and to their more perfect acquaintance with the general science and practice of surgery. Indeed, success in operative surgery depends greatly upon the selection of proper cases. The practice of operating in notoriously hopeless cases with the view of giving the patient what is called a last chance, is much to be deprecated, and should never be followed. It is by operating under such circumstances, especially in cancerous diseases, that much discredit has resulted to surgery; for in a great number of instances the patient's death is hastened by the procedure, which, instead of giving him a last chance, only causes him to be despatched sooner than would otherwise have happened.

CONDITIONS INFLUENCING THE SUCCESS OF OPERATIONS.—The circumstances that mainly influence the result of an operation, so far as the recovery of the patient is concerned, may be arranged under three heads — 1. Those that are connected with the *State of the Patient's General Health* at the time of its performance; 2. The *Hygienic Conditions* by which he is surrounded after it is done; and 3. The *Special Dangers* connected with the operation itself.

1. The condition of a patient that principally determines the result of an operation is the *State of his General Health*. Indeed, success is influenced by the state of the patient's constitution far more than by the severity of an operation, or by the mechanical dexterity with which the surgeon performs it. How often do we not see a patient carried off by fatal disease supervening on some extremely trifling operation, such as the removal of a small encysted tumour, for instance, which could in no way endanger life, were it not that the patient's constitution was at the time of its performance in so unhealthy a state that the slightest exciting cause has been sufficient to call into activity fatal disease! So, also, it is no uncommon circumstance to see patients sink after the most dexterously performed operations for hernia, stone, the ligature of arteries, &c., owing to some morbid condition of the blood or of the system that disposes to low or diffuse inflammation; whilst, on the other hand, some patients will make the most remarkable and rapid recoveries after they have been mutilated with but little skill. Persons of an irritable and anxious mind do not bear operations so well as those of a more tranquil mental constitution. Those also of a feeble and irritable habit of body, especially nervous and hysterical women, with little power of circulation, cannot bear up against severe surgical procedures; being apt to become depressed and exhausted, and to sink without rallying. Persons who are overloaded with fat are not good subjects for surgical operations. In them the circulation is usually feeble; the wound heals slowly, and is apt to become sloughy and intercurrent; and disease of a low type often sets in. Short of actual structural disease of important organs, as the lungs, heart, or kidneys, I know of no condition more unfavourable to success after operations than premature or excessive obesity.

An individual of a sound constitution, that has never been impaired by excesses of any kind, whose habits have been temperate and sober, whose diet has been sufficient and of good quality, whose mind has never been overstrained by the anxieties of business or the labours of a professional life, and whose existence has been spent in rural occupations and in the pure air of the country, is necessarily placed in a far more favourable position to bear the effects of any mutilation, whether it be the result of injury, or be inflicted by the surgeon's knife, than is the poor inhabitant of a large and densely peopled town, who has from earliest childhood inhaled

is of great consequence. On this point it is impossible to lay down any very definite rule, as much depends not only on the patient's previous habits of life, but on the nature of the operation itself; and as this subject will be discussed at the end of the chapter, it need not detain us here. It is not, however, often that in civil practice the insufficient quantity or the bad quality of the patient's food, with which he is supplied after the performance, influences materially the result of an operation. But in military and naval practice the case is far different. The soldier or the sailor on active service is often exposed to serious injuries that necessitate the more important operations at a time when his constitutional powers have already been broken down by scurvy, dysentery, or some other similar affection, resulting not so much from the deficient quantity as from the unwholesome character of the food with which alone he can be supplied. And after the operation his only available nutriment may be of the coarsest character, possibly salted and imperfectly cooked. Under such circumstances operation-wounds do not heal, or they assume a peculiar gangrenous character; or the patient sinks from ulceration of the intestinal mucous membrane. The mortality of operations becomes enormously increased; and there can be little doubt that many deaths which occurred during the disasters of the first winter of the Crimean campaign might be attributed to these causes.

The exposure of a patient after an operation to *contagious emanations* from other sick or wounded patients, may be attended by the most fatal consequences. Whenever it is practicable, every case of erysipelas, inflamed absorbents or veins, or hospital gangrene, should be rigorously excluded from the same ward or room in which other patients with operation-wounds happen to be lying; and, if possible, the same nurses, dressers, or surgeons should not be allowed to go from the infected to the healthy, nor should the same dressings or sponges be used for both. Every hospital surgeon must have had occasion to deplore many deaths after operation, arising from want of attention to this precaution.

Perhaps there is no hygienic condition of greater importance, so far as the results of operations are concerned, than the avoidance of the *overcrowding* of operation-cases or of injured persons in one ward or building; more particularly if the wounds be in a suppurating state. Under these circumstances, the atmosphere becomes loaded with animal exhalations in a state of putrescence or fermentation. These are absorbed by the lungs and skin, or the pulmonary and cutaneous surfaces are unable to set free their excreta in an atmosphere already surcharged; the blood becomes thereby vitiated, and low, diffuse, or erysipelatous inflammations of all kinds, with pyemia, or sloughing phagedena, are the necessary consequences. The space afforded to each patient in the surgical ward of an hospital, when patients with suppurating wounds are mixed with others suffering from such injuries as simple fractures unattended by breach of surface, should be at least 1500 cubic feet. If the proportion of simple cases be great, less than this may be safe; but if the majority of the patients have suppurating wounds, more space, as much even as 1800 cubic feet, should, if possible, be allowed. Whenever we have had an outbreak of the confirmed low surgical inflammations—of erysipelas, sloughing phagedena, and pyemia—in my wards at University College Hospital, it has been owing to the accidental and, perhaps, unavoidable accumulation of a large number of serious injuries or of operation-cases in one ward, so that the cubic space for patients became reduced materially below the figures above stated. Not only is space required, but *change of air*, by proper ventilation, is equally *useful*. For, however large the cubic space for patients, the air, if not

changed rapidly enough, soon becomes loaded with animal exhalations, and highly unalubrious. Hence care should be taken that a free current of pure air be maintained day and night through the ward. It is from want of this precaution during night that much mischief often results. The importance of maintaining efficient ventilation during night, and the little danger to be apprehended from the admission of night air, has been so forcibly pointed out by Miss Nightingale in her *Notes on Nursing*, and is now so universally admitted, that I need do no more than add the testimony of my experience to the truth of her observations. In cold weather, also, there is so great a disposition on the part of nurses and patients to shut up wards and rooms, that the air becomes close, oppressive, and contaminated; and hence it is that the erysipelatous and miasmatic diseases are so rife during winter and early spring. The "East Wind" is commonly accused as being the cause of these; and no doubt it is so, but only indirectly, by causing windows and doors to be shut, so as to exclude the cold that usually accompanies that wind, and thus rendering the atmosphere impure. It is impossible to overestimate the importance of a free supply of pure air in lessening the mortality after operations, not only in hospitals, but equally in private dwellings. Hence the performance of operations in close and ill-ventilated rooms, or in houses situated in overcrowded, badly-drained neighbourhoods, should, as far as possible, be avoided and the patient can be placed in more favourable hygienic conditions.

The mortality arising from inattention to these various hygienic conditions is not a necessity of the operation, but rises or falls according as the circumstances in which the patient is placed depart more or less widely from those conditions that are necessary to the maintenance of health. It is by the induction of pyæmia and of the erysipelatous inflammations, with fever of a fatal type, that the neglect of the hygienic conditions of operated patients destroys life. The prevalence of these diseases in a locality or an institution is the measure of, and in direct proportion to, the deteriorated constitutions of the inhabitants, and the breach of sanitary laws.

3. The *Special Conditions directly excited by the Operation itself*, though disregarded as to by the circumstances that we have just been considering, and which commonly lead to a fatal result, of which they are the immediate occasion, are the following:—shock, exhaustion, hemorrhage, gangrene, tetanus, internal inflammation of an acute kind excited by the operation itself, pyæmia, and the various low, diffuse, and erysipelatous inflammations. These causes of death are so various, and comprise so many distinct diseases, that I shall do little more here than mention them; referring the reader to the different chapters in the body of the work, in which each is specially treated.

The *Shock of an Operation* may prove fatal in various ways: from the severity of the mutilation, as in a case of double amputation; from the serious centres being implicated, as in the removal from the face of large tumours, that have connections with the base of the skull; from fear, or from the state of nervous depression into which the patient has previously fallen, causing him to feel the influence of an operation disproportionately to its severity. These various effects of shock have, however, been much lessened since chloroform has been generally administered in operative surgery. Chloroform, however, does not remove the physical impression produced on the system by a severe mutilation, hence the influence of a serious and prolonged operation is still manifested in the production of shock, of collapse, of a recovery, even though the patient has suffered no actual pain. Certain operations appear to exercise a peculiar depressing effect on the

nervous system, even though no pain be experienced. Thus, in castration, at the moment of the division of the spermatic cord, I have often observed the pulse to sink, even though the patient has been fully anaesthetised. So much is thus the case, that it is well at that moment to suspend the administration of the chloroform.

Exhaustion, without any tangible local or constitutional disease, is an occasional cause of death after severe operations; more particularly in delicate females, in feeble or debilitated subjects, or in those who have lost much blood.

Hæmorrhage, if very copious, may destroy the patient by inducing syncope that may be immediately fatal; or by increasing the influence of the shock so that he cannot rally; or it may be followed by serious after-consequences, such as the supervention of hæmorrhagic or irritative fever, and a disposition to the occurrence of low and erysipelatous inflammations. It is in these secondary and indirect effects that the great danger of excessive hæmorrhage lies. Patients who have lost much blood make slow recoveries, often interrupted by intercurrent diseases; and not unfrequently die at the end of two or three weeks, from some asthenic visceral complication. In fact, it is in this way, rather than from its immediately dangerous consequences, that the loss of a large quantity of blood at an operation proves injurious to the patient. When hæmorrhage occurs a few hours, or a day or two, after an operation, it usually proceeds from imperfect ligature of the vessels, or from arteries bleeding after the setting-in of reaction, which had not furnished blood whilst the patient was under the influence of the shock of operation. On recovery from chloroform also, it not unfrequently happens that arteries begin to spout, which yielded little or no blood whilst the patient was in a state of anaesthesia. Under these circumstances, hæmorrhage is of far less moment, and less frequently fatal, than when it occurs at a later period, in consequence of some morbid condition of the wound or system, and usually in association with a typhoid state, by which the proper formation of plastic matter is interfered with. During the performance of an operation, hæmorrhage should, as much as possible, be prevented; the operation itself is a cause of depression, and any great loss of blood not only seriously aggravates this, but disposes to the after-occurrence of pyæmia and low inflammations.

The Performance of an Operation during the Existence of any Acute Inflammation, as of a joint, for instance, is always attended by great danger. This is more especially the case if the disease be an inflammation of a low form, as phlebitis or erysipelas. So great is the danger of performing any, even the most trifling operations, in cases of this kind, that they never should be undertaken, except such—the ligature of a bleeding vessel for instance—as may be imperatively required for the immediate preservation of life. The danger in these cases is from the supervention of pyæmia. This appears to be occasioned by the blood, in such cases, being loaded with a quantity of effete materials, which run into a state of suppurative disorganisation under the influence of the new inflammatory action set up by the operation.

Gangrene is not a common cause of death after operations. In some cases of amputation, however, it may occur in the stump; after the operation for strangulated hernia, in consequence of the constriction of the gut; or in any wound in its contagious form of sloughing phagedæna.

Tetanus but rarely occasions death after operations in this country. When it does occur, it is frequently after the lesser rather than after the greater operations that it develops itself.

Internal Inflammations of an acute and active character may carry off the

patient after an operation, in two ways. They may have existed antecedently to the operation, being the disease for which it is performed, but, continuing their course unchecked by it, may destroy life. Thus when a child dies after tracheotomy for croup, death is not in general occasioned by the operation, but by the extension of the disease for which it has been practised. Or they may occur as the necessary and direct consequence of the operation. Thus, when a patient dies of peritonitis, after the operation for strangulated hernia, or of arachnitis, after his skull has been trephined, death may be the effect of an inflammation directly occasioned by the operation itself. But it is not by the action of any of these direct effects that an operation usually proves fatal. In the great majority of instances, death is occasioned in a more indirect manner by the development of pyæmia, or of some of those low and erysipelatous inflammations which are allied to it, and to which a respect of hygienic laws acts as a powerful predisposing cause.

Pyæmia is certainly the most frequent cause of death after operations, more particularly in large towns. It is especially and directly predisposed to by the neglect of hygienic laws by the patient previously to the performance of the operation, and by the unfavourable sanitary conditions by which he may be surrounded subsequently to its performance. Closely allied to pyæmia, frequently co-existing with it, predisposed to by the same causes, and associated with febrile disturbance of an asthenic type, are the various *septic* and *suppurative* inflammations, whether assuming the form of erysipelas, of phlegmon, or of inflammation of the absorbents, which are the dread of surgeons and the scourge of hospitals. It is to pyæmia, and to these various *septic* erysipelatous and low inflammations, with their attendant constitutional disturbance of an asthenic type, that at least three-fourths of the deaths after operations are due. It is in the production of these diseases that an impure blood, loaded with effete materials retained through habitual neglect of the ordinary rules of health or through defective elimination by the kidneys and skin, acts as a potent predisposing cause, requiring but some injury or wound to call into activity a most dangerous amount of local inflammation and of constitutional disturbance. Under such circumstances, it is not the extent or size of the wound that determines the dangerous results. The mere fact of a breach of surface, however trivial, is sufficient to excite these morbid processes, the materials for which have been previously stored up in the system. In such conditions of the system, the amputation of a toe may be as fatal as that of the thigh, or the removal of a small scarp atheroma as the ablation of the breast; the only additional danger essentially connected with the greater operations being the increased risk from shock and hemorrhage.

PREPARATION FOR OPERATION.—The surgeon, being convinced of the necessity of having recourse to operation, should proceed fully and unreservedly to lay before his patient the state of the case, and, if necessary, to give the reasons that render an operation imperative, in order to obtain his consent, and that of his family. In the event of the patient refusing to submit, what course should the surgeon pursue? In this he must be guided partly by the nature of the proposed operation; and partly by the state of the patient, and his capability of forming a correct judgment of his case. If the operation be one of expediency, merely for the relief of an infirmity or the removal of an ailment which does not directly jeopardise life, most certainly no surgeon would think of undertaking it without the full consent of the patient. If, on the other hand, it be an operation that is imperatively necessary for the preservation of life, in which the delay of a few minutes or hours may be fatal to the patient, as in the case of the proposed ligature of a

wounded artery, or the relief of a strangulated hernia, and where the patient, not being aware of, or capable of being made to understand, the necessity for immediate action, is unwilling to assent to the proposal, the surgeon will truly be placed in a dilemma of anxious responsibility; between allowing the patient to fall a sacrifice to his ignorance or timidity, and attempting, perhaps unsuccessfully, to rescue him from inevitable death against his own consent. I believe the proper course for the surgeon to pursue under such circumstances, is to judge for the patient in a matter on which he is clearly unable to form an opinion, and to compel him, so far as practicable, to submit to the necessary steps for the preservation of his life, or to put him under chloroform, and, when he is narcotised, to perform any operation that may be necessary. In the event of the patient being insensible, as after an injury of the head, the surgeon must necessarily take upon himself to act as the case requires. Children cannot be considered capable of giving an opinion as to the propriety of an operation; the consent of the parents is here necessary, and quite sufficient; and in their absence, the case being an urgent one, the surgeon must stand *in loco parentis*, and take all responsibility upon himself.

These points then having been determined, the patient should be *Prepared for the Operation*, if the case be sufficiently chronic to admit of the necessary delay. In a great number of cases requiring operation, as in strangulated hernia, bad compound fracture, &c., no time is allowed for preparation, but the surgeon must at once submit the patient to the knife, whatever the state of his constitution may be. But in the more chronic cases, time is given for improving the constitution. This preparation must not consist in any routine system of purging and starving, which is ill calculated to support the constitution against the call that will be made upon its powers; nor, on the other hand, in a tonic or stimulating regimen, which may produce fever and irritate the constitution; but in adapting our means to the condition of the patient and the nature of the operation to be performed. The tendency to erysipelas, pyæmia, and low and diffuse inflammations generally, is materially lessened by supporting the patient's strength, by means of a nutritious diet, previously to the performance of the operation. Indeed, in many of the more severe cases of compound fracture and disease of the joints, it is only by the use of a nutritious diet, and by the administration of tonics, quinine, or iron, and stimulants, often in large quantities, that the patient can be brought into a condition to bear the shock and consequent depression of the operation. It may even be found necessary to administer from half-a-pint to a pint of brandy, with perhaps a considerable quantity of wine, together with eggs, beef tea, and other nourishment, for some days before the operation can be undertaken. This is more particularly the case with hospital patients of bad constitution, who have met with serious accidents, attended by much suppuration and irritative fever. In the more chronic cases, the time should be seized for the operation when the secretions are free, the tongue clean, and the action of the skin and kidneys in a healthy state; and, above all, the mind should be kept tranquil and hopeful, being allowed to dwell as little as possible upon the impending event. In many operations, as those on the rectum and urinary organs, or in those of a plastic character, special modes of preparation are required, which will be discussed when we come to treat of the operations in detail.

The *Immediate Precautions* for the operation should always be superintended by the surgeon himself. He must see that the table is solid, and of a convenient height, well covered with blankets, and provided with pillows; and that the light of the room is good. There must be a sufficient supply of

glasses and of basons, with hot and cold water; and if the operation be likely to be attended by much hemorrhage, a tray filled with sand or saw-dust should be provided, in order to catch the blood. The surgeon must then look over his instruments, comparing them, if the operation be complicated, with what previously made out; he must see that they are arranged in the order in which they are wanted, and properly covered with a towel. Much of the successful performance of an operation depends on the attention and skillfulness of the assistants. Of these there should be enough, but not too many. In all capital operations three or four will be required; one for the administration of the chloroform, another to command the artery, a third immediately to assist the surgeon, and the fourth to hand sponges, instruments, &c. The duties of the assistants should be performed in silence, and each man must carefully attend to his own business, and not neglect this; as is too often done, in his anxiety to crane over and see what the surgeon is about. There should be no unnecessary talking when once the patient is on the table, the surgeon's directions being conveyed by a brief word or two, by a look, or by a sign with the hand.

The surgeon himself must always feel the heavy responsibility that hangs over him during the performance of a great operation—"at that moment when," as Dr. Grant has elegantly said, "Death everywhere surrounds his life as he is endeavouring to convey all his knowledge to its point." But having carefully considered each successive step of the operation, provided for every emergency that can by any possibility arise in the course of it, and trusting in Him, from whom all knowledge is derived, to strengthen his judgment and guide his hand aright, he will proceed to the performance of his duty with self reliance, and in the full confidence of being able to effect all that Art can accomplish.

ANÆSTHETIC.—The employment of *anæsthetics* in surgery is undoubtedly one of the greatest boons ever conferred upon mankind. To the patient it is invaluable in preventing the occurrence of pain, and to the surgeon in relieving him from the distress of inflicting it. Anæsthesia is not, however, an unmixed good. Every agent by which it can be induced produces a powerful impression on the system, and may occasion dangerous consequences when too freely or carelessly given; and, even with every possible care, it appears certain that the inhalation of chloroform is in some cases almost inevitably fatal. We cannot purchase immunity from suffering without incurring a certain degree of danger. There can, however, be little doubt that many of the deaths that have followed the inhalation of chloroform have resulted from want of knowledge or of due care on the part of the administrators. Yet, whatever be the precautions taken, there is reason to fear that a fatal result must occasionally happen. This immediate risk, which is but very trifling, is more than counterbalanced by the immunity from other dangers during operations which used formerly to occur.

There is, however, another question in relation to chloroform which deserves the most serious consideration on the part of the surgeon; viz., Does it influence the rate of mortality after operations? On this point there is conflicting testimony. Dr. Simpson has published statistics to show that the mortality after operations has lessened since the introduction of chloroform. Dr. J. Arnott, on the other hand, adduces figures to prove that it has materially increased, in amputation by 12, in lithotomy by as much as 28, per cent. I am inclined to believe that the rate of mortality has increased since the use of chloroform in operative surgery. But is this increase altogether due to any effect produced on the system by the inhalation of chloroform? May it not, in some measure at least, be owing to operations being

often performed in very doubtful or extreme cases, now that they can be done painlessly, when formerly the suffering inflicted would have deterred the surgeon from proposing, or the patient from acceding to, their performance? A surgical operation was formerly, from the pain attending it, looked upon as a more serious affair than it is at the present day, and surgeons were not willing to inflict suffering unless there were a good prospect of a successful issue. Now, however, that the most serious operations can be performed without any consciousness to suffering, the surgeon, in his anxiety to give his patient a chance of life, may not unfrequently operate for disease or injury that would otherwise necessarily and speedily be fatal, and which formerly would have been left without an attempt at relief.

Making, however, all allowance for the extension of operative surgery to extreme cases that were formerly not thought to come within its range, I cannot but think that chloroform does exercise a noxious influence on the constitution, and does lessen the prospect of recovery in certain states of the system, more especially when the nervous power is enfeebled or the blood is in an unhealthy state. Under such circumstances, the depressing influence of chloroform appears to me to act injuriously; the patient does not rally well after the operation for which it is administered, and immunity from suffering is purchased by a lessened chance of recovery.

Anæsthesia by the Administration of Chloroform is best commenced before the patient leaves his bed. The chloroform should never be given but by a person accustomed to its use, and on whose capability the surgeon has full reliance; as nothing embarrasses more, during an operation, than to have any doubt about the chloroform being properly administered. Chloroform may be administered in many different ways, either on lint or a handkerchief, or through an inhaler of some kind. The following is the way in which chloroform may most safely be given on lint or a handkerchief, without apparatus of any kind. On a piece of folded lint, about two inches square, and consisting of three doubles, about a drachm of chloroform is poured; and the lint is then held at a distance of about three inches from the nose of the patient, so as to permit a very free admixture of air with the first few inhalations of the vapour. After the lapse of about half a minute, the lint is brought nearer to the patient's nose, to within a distance of perhaps an inch, being never allowed to touch; at the same time a porous towel, not doubled, is lightly laid over the face of the patient and the hand of the operator, so as to prevent the escape of the chloroform vapour, but not to interfere with the admission of air. During the whole time, it is the duty of the administrator to keep his hand on the pulse, to watch the breathing, and occasionally to examine the pupils of the patient.

The method just described (giving chloroform on lint, the patient's head being covered with a towel) answers well enough in most cases, but it affords no means of ascertaining the proportion of chloroform which is being inhaled by the patient. The administrator can judge only by the effects produced. There is a danger of the patient's lungs being filled with a very strong mixture at the moment when the signs of an overdose are first perceived. Under the most favourable circumstances, it requires several respirations to replace the strong dose by fresh air; but if the patient happen to be in a rigid state, or his glottis be closed by spasm, considerable delay will occur, during which time, if the dose have not been strong enough to arrest the action of the heart, the blood is passing through the lungs and becoming further charged with chloroform.

Various inhalers have been contrived for the purpose of regulating the

proportion of chloroform with accuracy. The simplest kind consists of a mask covering the nose and mouth, with a box for sponge or blotting paper, on which the chloroform is poured, and with valves to prevent the expired air from passing through the chloroform chamber. The objection to this form is, that it yields a very strong mixture at first; and, when the chloroform has half evaporated, the remainder is so cooled that it evaporates too slowly to yield enough chloroform to insure the quietude of the patient, especially if he should move his head about so as to get a small quantity of air between his face and the mouthpiece.

Dr. Snow improved this apparatus by surrounding the chloroform chamber with water, and also making the upper valve movable, so that at the beginning of the inhalations only a portion of the inspired air should pass over the chloroform. This was a great improvement; but accuracy was not secured, because the proportion of chloroform given up varies with the temperature of the room, with the slowness or rapidity of the patient's breathing, and with the cooling of the chloroform, which is not entirely prevented by the water-jacket.

My experience with Mr. Clover's instrument is of the most favourable character. I have had

chloroform administered to several hundreds of my patients by it, with no accident or cause for anxiety. It consists of a bag holding 8000 cubic inches of air, which is suspended from the coat collar at the back of the administrator, and connected with the face-piece by a flexible tube (Fig 1). The bag is charged by means of a bellows (Fig 2, 1) measuring 1000 cubic inches; and the air is passed through a box warmed with hot water, into which is introduced, at each filling of the bellows, as much chloroform as is required for 1000 inches of air. This is done with a graduated glass syringe (Fig. 2, 2) adjusted by a screw on the piston-rod to take up no more than the quantity determined on, which is usually from 30 to 40 minims.

When the bag is full enough, the tube is removed from the evaporating vessel, and the mouthpiece (Fig. 2, 3)

is applied to the

The patient cannot get a stronger dose than the bag is charged with; but



Fig 1—Administration of Chloroform



Fig 2—Clover's Chloroform Apparatus.

the proportion can be made any degree weaker, by regulating the size of an opening in the mouthpiece, which admits additional air.

The principal points to be attended to during the inhalation of this potent agent are, that it be not given too suddenly, or in too concentrated a form; and that, whilst under its influence, the patient be not raised into the erect or sitting position. If lint is used, it may be too much saturated, and be held too closely applied to the mouth and nostrils; and the patient will not be able to get sufficient atmospheric air, and may speedily become partially asphyxiated, choking violently, struggling to get free, and becoming purple in the face, with a full slow pulse. Care should be taken not to compress the abdomen in holding the patient; for, as the respiration becomes chiefly or wholly diaphragmatic, it may be seriously interrupted by any pressure on the abdominal wall. Whilst under the influence of chloroform, the patient should never be raised up, as has just been stated; for, as this agent exercises a powerful sedative action on the heart, sudden and perhaps fatal syncope may ensue from putting the patient in the erect position. Hence, also, it is dangerous to administer it in those operations that require to be performed whilst the patient is erect. It is well to caution the patient not to take anything to eat for two or three hours before its administration, lest it induce vomiting of the partially digested meal. With due caution, it may be given with perfect safety to individuals of all ages. I have operated on infants less than a month old, as well as on octogenarians, under its influence. In administering it to young children, Dr. Snow recommends its dilution with rectified spirit.

The first influence of chloroform appears to be exercised upon the nervous system. The patient becomes excited and talkative, and a state of unconsciousness is induced, the muscular system at the same time being rendered rigid and tense. At this time the heart's action is usually quickened, and more forcible than natural. As the administration of the chloroform continues, however, complete paralysis of sense and motion is induced. The patient becomes altogether unconscious to all external impressions, the muscles become relaxed, and the action of the heart slow and feeble. This diminution in the power of the heart's action is well marked in the lessened force of the jet of blood from cut arteries. The respirations become shallow and feeble, in proportion as the sensibility of the nervous system and the energy of the muscular movements are lessened, and the blood in the arteries becomes dark; in fact, a semi-asphyxial state sets in. When thus fully anaesthetised, the patient is on the very verge of death, and requires the most careful watching on the part of the person who administers the chloroform; his fingers should never be off the pulse, nor his eyes taken away from the countenance of the patient. The breathing should be very carefully watched: when it becomes embarrassed the chloroform must be given sparingly, and when it becomes stertorous it should be discontinued entirely. In this state the inhalation of a small additional quantity of this potent agent, the application of the vapour in too concentrated a state, or the sudden raising up of the patient, might occasion a fatal result from paralysis of the heart.

If the inhalation of chloroform have been suspended, great care should be taken when its administration is recommenced, lest the already enfeebled heart be entirely overpowered by the sudden exhibition of too large a volume of vapour in a concentrated form.

It should be borne in mind that it is not necessary in all operations to administer chloroform to the same extent. In all the greater operations, as

amputations, lithotomy, and the ligature of arteries, enough should be given to completely paralyse muscular movement, as well as to suspend sensibility and consciousness. In operations for hernia, also, and all other proceedings implicating the abdominal walls, if complete muscular relaxation be not induced, great inconvenience and not a little danger may result. So, also, in very painful operations about the anus and genital organs, a full dose of chloroform should be given. But for the removal of many tumours about the trunk, or in many of the minor operations on the extremities and about the head and face, muscular relaxation is not so necessary; and it will be sufficient to give enough chloroform merely to suspend sensibility and consciousness to pain.

In certain diseased conditions of the system the administration of chloroform requires much care; but, as a general rule, it may be stated that whenever the constitutional disease has not advanced to such a degree as to contraindicate an operation, chloroform may be given. In the early stages of phthisis it may usually be safely inhaled; but in some cases of bronchial irritation the vapour is apt to produce troublesome cough. When the heart is diseased, great caution is necessary, more particularly when its muscular substance has undergone fatty degeneration; the sedative influence of the chloroform being apt to produce a sudden depression or arrest of the heart's action under these circumstances. In many, perhaps the majority, of the cases of death from chloroform, the fatal event has been traced to this cause. In valvular disease of the heart, I believe that it may be more safely given. In persons who are epileptic, and in those who suffer from congestion of the brain, it requires to be cautiously administered, as in the earlier stages of anæsthesia much cerebral excitement is apt to be evinced. In hysterical subjects, chloroform is said to induce a tendency to laryngeal spasm. The most dangerous condition in which to administer chloroform is that in which, in consequence of renal disease, the blood is loaded with urea: in such cases epileptiform convulsions are readily induced, with lividity of the face, and a tendency to stertor and coma.

Should chloroform be given in operations rendered necessary by severe injuries, during the period of the continuance of the shock of the accident, as in primary amputations? Under such circumstances, its use has been objected to on the ground that it would act injuriously by still further lowering the already depressed vital powers; and that the pain of the operation, if performed without it, would prove a good stimulant, and thus serve to rouse the patient. But would this really be so? Is the pain of an operation a stimulant? In order to answer this question, let us observe the condition of a patient immediately after the performance of a severe operation—as an amputation—without his having been anæsthetised; and we shall find that, so far from having been restored or stimulated, he will have been seriously depressed by it. The pulse will be small, feeble, and slow, the surface cold; and the mind, perhaps, scarcely conscious: in fact, though a slight degree of pain, as a pinch or a prick, may act as a stimulant, very severe suffering is a most powerful depressing agent, capable in itself of destroying life. The pain of an operation performed soon after the occurrence of a severe injury, so far from rousing the patient, appears to me to act most injuriously, by inflicting a second shock upon the system before, perhaps, it has fairly recovered from the depressing effects of the first; and it is by preventing this, that chloroform is of such inestimable advantage. In these cases it is not necessary to give chloroform to an extreme degree of anæsthesiation. It is only requisite to give it to a moderate extent, chiefly so as to benumb sensation during the incisions made

through the skin. After this, and during the later stages of the operation, the inhalation may be suspended entirely, or nearly so.

Death from Chloroform may occur in three different ways; viz., by *coma*, *asphyxia*, or by *syncope*; through the brain, the lungs, or the heart.

When death occurs by *coma*, the patient is heard suddenly to breathe stertorously; he becomes livid in the face, and is convulsed; the heart continues to beat until the last moment of life, and death appears to result primarily from the circulation of dark blood through the nervous centres. This form of death chiefly occurs in individuals who are epileptics, or whose blood is loaded with urea. When death occurs by *asphyxia*, it is the fault of the administrator, sufficient air not being admixed with the chloroform vapour to maintain the respiratory function. The symptoms are those of ordinary asphyxia, consisting of lividity of the surface, distension of the jugulars, struggling for breath, and speedy cessation of the heart's action. In some cases death is not immediate, but a low form of congestive pneumonia sets in, the blood never becomes properly aerated, and death ensues in a few days, the direct effects of the chloroform never having completely gone off. In death from *cardiac syncope*, the patient, after a few inspirations, suddenly becomes pale and faint; the pulse beats in a flickering manner a few times and then ceases, though respiration may continue; the fatal event being evidently due to paralysis of the heart. This is an accident that may occur to individuals who are depressed either by mental emotion or by physical debility before taking the chloroform; and it is not unfrequently connected with a fatty heart. It is best guarded against by giving the patient a little stimulant, as brandy or ammonia, before commencing the inhalation.

The *Treatment of the Effects arising from an Overdose of Chloroform* is conducted on two principles:—1, the establishment of respiration, either natural or artificial, so as to empty the lungs of the vapour contained in the air cells, and to aid the oxygenation of the blood; and 2, the stimulation of the heart's action, and the maintenance of the circulation.

The first principle of treatment—that of re-establishing respiration—is most serviceable in the asphyxial form; the other, that of stimulating the heart, when the syncopal symptoms are present. But in all cases they may most advantageously be employed in combination.

The treatment to be adopted on the occurrence of dangerous symptoms, or of apparent death from chloroform, is as follows:—

1. The administration of the vapour must at once be discontinued.
2. The tongue should be seized with the fingers, or with a hook or forceps, and drawn out of the mouth; and the larynx pushed up so that the glottis may be opened.
3. Fresh air should be admitted to the patient by opening doors and windows, and by preventing bystanders or spectators from crowding round.
4. All constrictions should be removed from the patient's throat and chest, and these parts should be freely exposed.
5. Artificial respiration must at once and without delay be set up, whilst these other measures are being carried out, either by the surgeon applying his mouth to the patient's lips, and thus breathing into the chest; or, what is preferable, by the alternate and steady compression and relaxation of the walls of the patient's chest.
6. Electricity should be applied freely over the heart and diaphragm through to the spine, by means of the electro-magnetic or other convenient apparatus.
7. *Fraction of the extremities* may be employed; a little brandy

rubbed inside the mouth ; and cold water dashed on the face, as accessory means.

The *Administration of Ether* is effected by the application over the nostrils of a flannel sponge saturated with the best washed ether. This mode is preferable to the use of any of the complicated inhalers ; inasmuch as, by the admixture in the sponge of a sufficient quantity of atmospheric air with the ethereal vapour, all danger of asphyxia is avoided. To prevent the pungent effects of ether on the cutaneous surface, Dr. Warren has proposed the anointing of the face with some protective unguent. The first effects of the inhalation are resistance on the part of the patient, and some slight irritation of the air passages ; the pulse is increased in rapidity, rising to one hundred pulsations per minute ; the face becomes flushed, and the movements and speech of the patient excited. This stage of excitement soon passes, and full etherization is then effected ; the pulse falls to sixty or seventy, the countenance becomes pale, insensibility to pain is produced, and the whole muscular system is relaxed. The indications of this state are the dropping of the upper eyelids, and the inability of the patient to sustain his arm when raised. This is the period most favourable to the performance of operations, and especially for the reduction of dislocations and of fractures attended with shortening of the limb. The time required for the induction of the anæsthetic state varies ; averaging, perhaps, about five minutes, a longer period than is required in the administration of chloroform, and attended with slightly more excitement. The fatal consequences which have attended the employment of chloroform have caused the American surgeons almost entirely to trust to ether in preference. Ether is certainly a safer agent than chloroform, but few deaths having resulted from its administration ; and the only argument in favour of the use of chloroform rather than ether is, that chloroform is the most convenient agent, its effects being produced more quickly, and no disagreeable smell being left behind, as is the case with ether.

Local Anæsthesia, by means of the application of a frigorific mixture of ice and snow, as introduced by Dr. J. Arnott, may very conveniently be employed in many cases in which the internal administration of anæsthetics is either inadmissible or inconvenient. It can only be produced with certainty, however, in those cases in which the incisions merely implicate the skin and subcutaneous structures, as in opening abscesses, sitting up sinusses, avulsion of the nails, or removing small and superficial tumours. For all such purposes, however, it is extremely valuable.

The mode of using the frigorific mixture is as follows. About a tumblerful of rough ice is put into a strong canvas bag, and finely powdered with a mallet. It is then poured out on a sheet of paper, and half its bulk of salt is quickly mixed with it by means of an ivory or wooden paper-knife. The mixture is then put into a muslin or gauze bag, suspended from a wooden ring, and applied to the part for from five to ten minutes. So soon as the skin becomes white, opaque, and hard, anæsthesia is produced, and the incisions may be made without any pain being experienced. The frozen part speedily recovers itself, no inconvenience resulting.

PERFORMANCE OF AN OPERATION.—The *Incisions* for the operation itself should be carefully and properly planned, so as to give sufficient space, with as little mutilation as possible ; and in some cases they must be arranged with the view of subsequent extension, should the state of things to be discovered require it. They should be made freely, without tailing ; the point of the knife being entered and withdrawn perpendicularly, and made to cut with a rapid sawing motion, due attention being at the same time paid to the resistance of the tissues, so that the surgeon does not, by using too

much force, plunge or jerk his scalpel or bistoury into the part. The scalpel should be set on a smooth ebony handle, which is less slippery than an ivory one when wetted with blood, and admits of greater delicacy of touch; it should be light in the blade, nearly straight-backed, and slightly belled on the cutting edge. When very free and extensive incisions are required, as in the removal of large tumours, &c., Liston's spring-backed bistoury, of proper size and shape, is a most convenient instrument. Whilst the incisions are being made, care must be taken that too much blood is not lost. This may be prevented most conveniently by the use of the tourniquet, or by an assistant compressing the main artery of the limb. If the seat of the operation be such as not to admit of this, the assistant must compress the bleeding vessels, as they are divided during the operation; and as soon as it is concluded, he must remove his fingers from them one by one, to admit of their being ligatured, or the hemorrhage arrested by acupressure. If oozing continue after all jetting vessels have been tied, it may be arrested by exposure to the air, or by pouring a stream of cold water upon the wound. In some cases the pressure of a pad and bandage, and in others that of a sand-bag, will arrest this bleeding; but in the majority of instances position and coaptation of the flaps will suffice.

The *Sutures* should be introduced at the time of the operation, whilst the patient is still under chloroform. If the wound be dressed at once, they are tied in the usual way, and the edges thus brought neatly together. If the dressing of the wound be deferred for a few hours, they should be left to hang loose, and not be drawn tight until the wound is dressed. In this way the patient is saved the pain, which is always much complained of, of introducing the sutures at the time of the dressing. They are generally best made of dentists' twist, of moderate thickness, so as not to cut out readily. Silver or unoxysisable iron wire forms an excellent material for sutures in the plastic operations, and in many other cases in which the silk thread is apt to irritate. In some cases, where much tension is exercised or great accuracy required, hare-lip pins are preferable to ordinary sutures.

Dressing of the Wound.—When the wound is small, and all oozing has ceased, its lips may at once be brought together. This may also be done, even when large, if the patient be of a very irritable constitution and sensitive to pain; the whole dressing being performed whilst he is still under the influence of chloroform. But in general, when the wound is extensive, as in cases of amputation, I prefer, and almost invariably adopt, the plan recommended by Mr. Liston, of leaving the wound open with a piece of wet lint interposed between its lips, for two or three hours, until its surface has become glazed; the lint is then carefully removed, any small coagula are gently taken away, and the sides of the incision brought into apposition, the sutures being drawn tight and tied. Long strips of plaster of moderate width should now be applied; these may be either of the isinglass or the common adhesive kind, each having advantages that recommend it in particular cases, with corresponding disadvantages that exclude it in others. The isinglass plaster is clean, unirritating, and, being transparent, allows a good view of subjacent parts; but it has the disadvantage of loosening and stripping off when moistened by the discharges or dressings, which often renders it a very inefficient support. The common adhesive plaster is more irritating and dirty, but it is much stronger and holds tighter, not loosening so readily when moistened. In large wounds, as in those of amputation, I prefer the isinglass for the first dressing, and leave it on until loosened by the discharges, and then use the common adhesive plaster for subsequent

general rule, it may be stated that, as an operation is a shock to the system, the constitutional powers usually require to be maintained after its performance. This is more particularly the case, if the mutilation be severe or the subsequent suppuration abundant. If the patient's strength be good, not having been broken by previous disease or suffering, and if the operation be a slight one, as the amputation of a finger, or the removal of a small tumour, he may have half his usual diet allowed for a few days, but without any stimulants. If the operation have been more severe, but not capital, no solids should be allowed, but broths and nourishing liquids alone given for the first few days. If the operation have been a capital one, the patient's health and strength being otherwise good, he may be restricted to farinaceous slops and beef-tea until suppuration has come on; indeed, up to this time, the febrile reaction will usually prevent the patient from taking solids. Some light pudding may then be added; and the diet may, as the case progresses, be gradually improved by the successive addition of fish and the lighter kinds of meat, with a moderate quantity of stimulants, as required, until it reach the normal standard. It not unfrequently happens, however, that a totally different course must be pursued. If the patient have been much reduced by long-continued suppuration, or other depressing causes before the operation; if he be old and weakly in constitution, or have been in the habit of taking a very considerable quantity of stimulants, it will be absolutely necessary to depart from the routine plan, and to adopt a tonic and stimulating mode of treatment. Indeed, in hospital practice especially, I find this by far the most successful mode of treating patients after severe operations; without it, many would have sunk, whom I have seen saved by the free administration of large quantities of brandy, wine, porter, eggs, and beef-tea, from the very time of the operation; that stimulant being given to which the patient is accustomed in a state of health. I believe also that this plan of treatment is the best preventive of those low and diffuse forms of inflammation that are so commonly fatal in these cases; and when they come on, I know of no better remedy than the brandy-and-egg mixture of the *Pharmacopœia*, freely administered. In all this, however, the surgeon must be guided by the patient's pulse, his previous habits, and the power of his constitution; and nothing requires greater judgment than the administration of stimulants, according to these particulars. The great importance of attending scrupulously to the general cleanliness of the patient, and to the ventilation of the ward or room in which he is lying, as the best means of preventing the occurrence of the lower forms of inflammatory mischief, need scarcely be insisted on, as these hygienic precautions are universally recognised as being of the first importance under such circumstances.

The various special operations will be considered when treating of the several injuries and diseases for which they are required; but, as amputations do not readily fall under any special head, being required for a vast variety of different conditions, it will be more convenient to consider them here.

CHAPTER II.

AMPUTATIONS AND DISARTICULATIONS.

THE term *Amputation* properly means the separation of a limb from the body, but it is sometimes applied to the removal of other parts, as the *breast or penis*. The frequency of amputations of the limbs has much

lessened of late years ; other and less severe modes of treatment being now successfully had recourse to in many cases of diseased joint, of aneurism, and of compound fracture, that were formerly submitted to the knife. But still amputations are amongst the most frequent operations in surgery, and will continue to be so as long as the human body is liable to severe mutilations, to gangrene of the limbs, and to malignant and other incurable diseases of the bones and joints. It has been somewhat the fashion to decry amputation, and to speak of this operation as an opprobrium to curative surgery. But, though no surgeon can deprecate unnecessary amputations more strongly than I do, yet I cannot admit that the removal of a limb differs from other operations, which are only attempted when all other means have failed in curing the diseased part, or saving the patient's life. And, surely, it is rather a subject of just pride than the reverse, for the surgeon to be able with ease, and by a simple operation, to save the whole of the body, though he sacrifice a limb that has been utterly and incurably diseased or spoiled by disease or injury. In the performance of an amputation, also, much dexterity may frequently be displayed ; and there is commonly great scope for surgical skill in the constitutional treatment of the patient both before and after the operation.

An amputation may be done in the continuity of a bone ; or at a joint, when it is called a *disarticulation*.

Hæmorrhage during the operation is the great primary danger which must be carefully guarded against. As a general rule, it is better to prevent this by the application of a tourniquet than by trusting to the compression of the artery by an assistant's fingers ; the tourniquet arresting the flow of blood through the collateral vessels as well as the main trunk, whilst an assistant can only stop the current of blood that passes through the latter. When the tourniquet is applied, the pad should be carefully placed over the artery, and the band buckled pretty tight : but the instrument should not be screwed up until the moment of the operation. It should then be tightened rapidly, so as to prevent the liability to congestion of the lower part of the limb that always occurs when a tourniquet is applied, but which is especially apt to occur when the instrument is slowly screwed up. The first effect of the tightening of the tourniquet is to compress the large veins of the limb ; the second, to arrest the flow of blood through the arteries : hence the more slowly it is caused to act, the greater will be the venous engorgement of the limb. The blood that flows from the limb during an amputation is almost entirely venous, from the lower part of the member. In those cases, as of *hæmorrhoids*, in which it is of great importance to save blood as much as possible to the patient, it is a good precaution to bandage the limb tightly from below upwards immediately before the tourniquet is applied ; thus preventing, to a great extent, the venous congestion. So soon as the main arteries have been tied after the removal of the limb, the tourniquet may be removed and taken off, the assistant, however, keeping his finger on the artery above the stump, lest any vessels have been left untied, or a ligature slip. If the band be left only half loosened, it will often happen that venous hæmorrhage continues abundantly from the stump, in consequence of the pressure of the instrument being still sufficient to prevent the return of the blood through the veins. This will at once cease on taking the tourniquet completely off, and elevating the cut surfaces.

In amputations and disarticulations, the surgeon has the choice of *two principal procedures* — the circular method, flaps ; a combination of the two, the formation of skin-flaps with a circular cut through the middle, or the rectangular flap. It is not my intention to enter into

a discussion as to the relative merits of the circular and flap methods, for which I would refer to the writings of Liston and Velpeau. I believe that by either the circular or the flap method an equally good stump may ultimately be formed; but that much will depend upon the special dexterity which the surgeon may have acquired by the habitual performance of one or other of these operations. Educated in the doctrines of Mr. Liston, who invariably amputated by the flap method, and who certainly did this with wonderful rapidity and precision, I have been in the habit of performing this operation in preference to the circular, over which it certainly possesses the special advantages of greater celerity in performance, more perfect coaptation and smoothness of the opposite sides of the wound, and a greater tendency to union of the stump by the first intention.

FLAP AMPUTATION.—In performing the flap amputation, the surgeon should always stand so that he may support and grasp the limb to be removed; the left hand being placed on the outer side in amputations of the left limbs, on the inner side in those of the right.

The *Amputating Instruments* must be in proper order, and of good construction. For the smaller amputations the surgeon will require straight spring-backed bistouries, in ivory handles, narrow or broad in the blade, according to the size of the part to be removed. Scalpels, also, not too broad in the blade, are useful in cases in which the bistoury, from its length, might be inconvenient. Cutting-pliers, with long and strong handles and short blades, either straight or curved, as may be most convenient, are especially required in amputations about the hands and feet. The knives for the larger amputations should have smooth ebony handles, and be well balanced. The back of the blade should run straight to the point and be well rounded. The edge should taper off towards the point, with a good convexity. The breadth of the blade should vary from $\frac{1}{8}$ to $\frac{1}{2}$ of an inch, and its length must be proportioned to the thickness of the limb to be removed. As a general rule, in order to make a good sweeping cut, so as to form a well-rounded and smooth flap, the blade should be in length equal to about double the thickness of the limb. The saw should be strong in the blade and back, so as not to bend in cutting. The blade must be of good breadth, and, in order not to hang as it works its way through the bone, must be somewhat thicker at the cutting edge than elsewhere. The teeth should not be too fine, and must be set crossways. The artery forceps may either be of the ordinary "bulldog" make, or they may be broad towards the point, so as to allow the knot more readily to be slipped over the vessel to be tied.

The *Flaps* may be made either by cutting from without inwards, or by transfixion—cutting from within outwards. I generally prefer transfixion in fleshy parts, as the thigh or arm; but cutting from without inwards will be found to afford the best result, and is indeed the only mode of forming the flap, in some situations where the bones are naturally thinly covered, as on the outer side of the fore-arm, the anterior part of the leg, or just above the ankle-joint, or where the soft parts have been wasted by chronic disease. The flaps should be made by a steady sweeping cut, so that the soft parts may be evenly and smoothly divided. Their length must of course be proportioned to the thickness of the limb; and on this point no positive directions can be given, except that care be taken that they be not cut too long nor too short. If they be cut too long, too much muscle will be left on the stump, and the flap itself is usually badly fashioned and pointed. Should the surgeon feel that he has made this mistake, the wiser plan will be at once to round off the ends of the flaps. Should they have been cut too short, the soft

habit of using "*retractors*," made of split pieces of linen cloth or of wash-leather. But, although "*retractors*" may not be required for the purpose of drawing back the soft parts, they are of great use in another way; viz., in protecting the muscles from the teeth of the saw and from the bone-dust produced by the action of that instrument: both these conditions—the laceration of the deep muscles by the saw, and the imbedding of particles of bone-dust in their substance—interfering seriously with union by the first intention. In order to saw the bone quickly and steadily, there are several points deserving attention. The first cut should be made so as to form a deep groove to receive the teeth, by pressing the left thumb on the bone, and applying the heel of the saw, held horizontally, along this, by which it is steadied; the instrument must then be drawn fairly and sharply along the whole line of its teeth from heel to point. The groove thus formed receives the edge of the saw; and the bone may then be quickly cut through by long, light, and sweeping movements of the instrument from point to heel, the position being gradually changed from the horizontal to the vertical as progress is made. The surgeon must, with his left hand, support the part to be removed; and care must be taken not to bear upon this, so as to snap the bone as it is weakened by the action of the saw; nor should it be so much raised as to run the risk of locking the saw. When there are two bones in the limb of equal strength, as in the fore-arm, they should be cut through at the same time; but in the leg, the fibula, being the weakest, should always be first divided. Should the division be made irregularly, and splinters of bone project, these must be snipped off with cutting pliers.

Ligatures.—After the limb has been removed, the ligatures should be applied. The main and larger arteries must first be tied. For this purpose, fine compressed *whipcord* is the best material. The ends of these ligatures, knotted together, must be left long, so that they may be distinguished. Usually from two to four or six smaller vessels require to be tied, and they should be secured with ordinary ligature-thread; but sometimes, either from the existence of malignant disease in the limb, or when extensive suppurative action has been going on in the limb, the stump is excessively vascular, and a very large number of ligatures may be required. I have more than once had occasion to apply between twenty and thirty ligatures to vessels in the arm and thigh under these circumstances. As union always takes place by granulation in such cases as these, it signifies little how many are put on, the smaller ones separating early. *Silver* or *iron wire* may be used for the purpose of ligaturing the arteries, with the view of preventing the suppuration that results from the irritation of the ordinary silk or thread ligatures, and thus facilitating union by the first intention. I have employed them in several instances, but have found this inconvenience resulting from their use, that they do not cut through the artery as the thread does, and consequently do not detach themselves, but require to be pulled or twisted off—a procedure likely to be attended by risk of hemorrhage. In order to obviate this, Dr. M. Sims proposes that they should be cut off close or left to be encapsuled. Thus I have also done; and certainly I have seen the wound unite over the silver wire ligatures so treated with the greatest rapidity, and almost without the discharge of a drop of pus, by the first intention; but yet the surgeon can never without some anxiety leave foreign metallic bodies to be encapsuled in a stump, lest they become the source of neuralgia. Free arterial bleeding will sometimes take place from a point in the cut surface of the bone, in consequence of the division of the *trunk of the nutritious artery*. This kind of hemorrhage is best arrested

by pressing a small wooden plug into the bleeding bone. To this a piece of wire should be attached, so that it may be drawn out when loosened by supuration at the end of a few days.

Sutures may be either of well waxed silk or of metallic wire. They should be introduced through the lips of the incisions at intervals of an inch, care being taken to leave the most dependent angles of the stump open, and to draw out the ligatures through them. In cases of primary amputation for injury, or in any case in which coozing is expected, the sutures should be introduced whilst the patient is under chloroform, and left loose. When this is done, silken sutures must be employed, and wet lint applied between the surfaces and over the outside, the dressing of the wound being deferred for a few hours, until the surfaces are glazed. But in amputations for disease, when patients are in a low and irritable condition, I think it is better to apply the dressings immediately after the performance of the amputation, before the effects of the chloroform are recovered from. In these cases I now always employ metallic sutures, which are less irritating, and may be retained longer. Before dressing the stump, it is desirable that all coozing should have ceased; and with this view, after the ligatures have been applied, I constantly pour a jug or two of cold water over the face of the stump, and then proceed with the dressings, which must be conducted in accordance with the general principles to be laid down in speaking of wounds. Strips of adhesive plaster, about fifteen inches long, may then be applied between the points of suture, and the stump bandaged from the upper part of the limb, as far as the line of incision, so as to bring together the deeper parts of the wound, more particularly where the bone interposes between the flaps. A piece of wet lint, kept constantly moist with cold water, should then be laid over the line of incision, and the stump comfortably supported on pillows. If union by the first intention fail, and suppuration set in, warm-water dressing, or linseed-meal poultices covered with oiled silk, must be substituted for the cold lint. If union take place by adhesion, the dressings, more especially the plasters, will not require very frequent changes, which are always painful to the patient. But if the union be by the second intention, and the suppuration be abundant, too much attention cannot be paid to cleanliness.

Erysipelas, with a more or less *sloughy condition of the stump*, not unfrequently occurs. In such cases all sutures should be at once taken out, and the strips of plaster either taken off or reduced to two, put on lightly so as merely to afford some degree of support. The stump should be enveloped in soft poultices, and well washed with warm water or disinfecting fluids at each change, great care being taken not to allow matter to be confined, or to loosen the ligatures. The constitutional treatment of the case must be conducted on the principles that will be detailed in the chapter on *Erysipelas*; but, as a general rule, it should be tonic and stimulating, dietetic rather than medicinal. Should secondary hemorrhage occur, it must be treated as will be hereafter described.

When suppuration is subsiding, and cicatrization going on, the bandage may advantageously be brought over the face of the stump. As a general rule, it will be found that a narrow roller will adapt itself better than a broad one. After cicatrization is completed, the patient should be allowed to go about on crutches, but must not wear an artificial limb for several months, until the parts have become firmly consolidated; during the whole of this time the stump should be kept carefully bandaged, and not exposed to injury.

OPERATION BY THE RECTANGULAR FLAP.—Mr. Teale, of Leeds, has of late years performed amputation by a long and a short rectangular flap, with

the view, as he states, of procuring a more useful stump, and in the



Fig. 3.—Flap in Teale's Amputation.

hope of somewhat diminishing the mortality of the operation. In performing amputation by this method, the long flap is cut from that side of the limb where the parts are generally devoid of large blood-vessels and nerves; whilst the short flap is made to include those structures which are cut across transversely, as shown in the annexed figures from Mr. Teale.

The long flap is perfectly rectangular; and the rule for its formation given by Mr. Teale is, that its length and breadth should each be equal to the half of the circumference of the limb at the place of amputation. If the circumference be 9 inches, the length and the breadth of the flap should be each $4\frac{1}{2}$ inches.

The short flap, which is always cut so as to contain the chief vessels and nerves, is one-fourth of the length of the long one.



Fig. 4.—Teale's Amputation. Stump.

After the bones have been divided in the usual way, and the vessels tied, the long flap is folded over the end of the bone, and attached by sutures, as on the accompanying figure (4), to the short flap.

Mr. Teale directs that the stump should be laid on a pillow lightly covered with gauze or linen, and protected from pressure by a cradle; but in the early treatment he says that no dressings are required.

The *Results* of amputation by this method have been very satisfactory in Mr. Teale's hands; but more abundant evidence than he at present possesses is required in order to show whether the mortality of amputations generally is dependent on the particular method adopted, rather than on constitutional causes and external influences that operate equally in all cases, whatever be the precise form of incision adopted for the removal of the limb.

The rectangular method undoubtedly possesses one very great advantage over the circular or ordinary flap, in giving a soft and thick covering to the ends of the bones, admitting of direct bearing upon them; especially advantageous after the amputation of the thigh or leg, when that direct pressure can scarcely be dispensed with, and when a solid, firm stump admitting of it is of very essential service to the patient. Mr. Teale advises, however, that the whole pressure be not borne by the stump, but that it be reduced to one half, the remainder being distributed in the usual way on the upper part of the limb and trunk: thus not only relieving the stump, but securing greater steadiness of gait and firmness of step. In the upper extremity, however, no direct pressure is made upon the end of the stump in the adaptation of artificial limbs; hence, in amputations of the fore-arm or arm, a thickly covered stump is not so much the object of the surgeon as in the leg and thigh. In the former instances therefore, the rectangular appears to possess an advantage over the double flap method, so far as the after utility of the stump is concerned.

But, whilst fully admitting the advantage possessed by the rectangular method in the formation of a well-cushioned stump, especially in the lower extremity, we must not close our eyes to certain disadvantages which appear to me to be inseparable from it. The disadvantage consists in the necessity of

found to be rounded, and the medullary canal filled up, the vessels being obliterated up to the nearest collateral branch (Fig. 5). The ends of the nerves are thickened, and commonly assume a bulbous appearance (Fig. 6). On examining these rounded or oval tumours, they will be found to be fibro-cellular masses, having nervous fibrillæ thinly scattered throughout.

The proper adaptation of *Artificial Limbs* is a matter of considerable consequence; and the ingenious mechanical contrivances that are at the present day adapted to stumps, leave little to be desired. The surgeon had better leave the details of these mechanical contrivances to the instrument-maker; but he should see that they are made light, consistently with sufficient strength and support, and that the end of the stump is never pressed upon by them. Thus, after amputation of the thigh, the artificial limb should take its bearing point from the lower part of the pelvis and hip. In amputation immediately below the knee, this joint should be bent and received into the socket of the instrument; and, if the amputation be at a lower point than this, and the stump be extended into the artificial limb, its end must be protected from injurious pressure. Even in the case of disarticulation at the ankle-joint, where the soft tissues of the heel are left, pressure can seldom be borne upon the end of the stump.

MORBID CONDITIONS OF STUMPS.—*Necrosis.*—It not unfrequently happens



Fig. 7.
Necrosed
Bone from stump.

that the end of the bone in a stump *necroses*. This occurs either in consequence of the injury inflicted by the jarring of the saw, or happens in those stumps that unite by the second intention, and where the bone consequently lies bathed in pus for a considerable time, being exposed between the flaps, and thus at last losing its vitality. This is especially apt to happen in persons of feeble constitution in whom the limb has, previously to the operation, been the seat of abscess that has denuded the bone or otherwise injured its vitality. In these cases a fistulous opening will be left leading down to the necrosed bone, which usually separates three or four months after the operation in the shape of a complete ring, with irregularly spiked prolongations stretching from its upper part (Fig. 7); after this has been removed, the stump becomes firmly consolidated.

Conical or "Sugar-loaf" Stumps, as they are called, commonly form either in consequence of the flaps having originally been cut too short, or from the bone not having been sawn off sufficiently high above the angle of the flaps; but in other cases they may occur, though the stump has been skilfully fashioned, in consequence of the soft parts which have been the seat of inflammatory action and suppuration before the amputation, retracting during the granulating process, so as to denude the bone. In such cases as these, great retraction and contraction of the flaps are apt to go on during cicatrization, so that the bone may never be covered at all, but be exposed at the bottom of an irritable ulcer; or, if the soft parts do coalesce, the cicatrix will be unable to support the slightest pressure without becoming ulcerated. Under these circumstances, the only remedy consists in laying open the stump, and cutting off about three inches of the bone.

If the stump be too long and projecting, so as constantly to be in the patient's way, there is no remedy but to perform a second amputation higher up. This is especially required in badly fashioned stumps of the leg, where

MORTALITY AFTER AMPUTATION.—The general causes of death after operations have already been considered; but we must now examine some special points connected with the relative mortality after amputations of different kinds, and the cause of the difference that exists. The principal causes of death after amputation are the influence of shock, the occurrence of secondary hemorrhage, pyemia, erysipelas, phlebitis, and congestive pneumonia; besides these, hospital gangrene and sloughing of the stump occasionally carry off the patient. Pyemia is the most frequent cause of death after amputations, nearly one half of the patients that die perishing from this disease. Mr. Bryant has shown that, at Guy's Hospital, it is fatal in ten per cent. of all amputations, and in forty-two per cent. of fatal cases, and that it is most frequent after amputations through limbs, the tissues of which are in a normal condition, and where a large surface of healthy bone is exposed, as in primary amputations, and in the removal of limbs for tumours, talipes, ankylosis, &c. It is not so common after amputations performed for chronic joint-disease or secondarily after injuries.

The circumstances which more specially influence the general result of amputations, as well as the particular cause of death after the operation, may be divided into two classes:—*a.* Those that have reference to the general constitutional condition of the patient. *β.* Those that are connected with the operation itself.

a. To the first class may be referred, 1, *Age*; 2, *General Health*; and 3, *Hygienic Conditions*.

1. *Age* exercises a material influence on the result of amputations. As a general rule it may be stated that, the younger the patient, the greater the likelihood of a successful result. At early periods of life also there is a great exemption from low secondary diseases of the erysipelatous type; and, if death occur, it is usually from exhaustion or intercurrent visceral mischief.

2. The *General Health* of the patient previously to the operation exercises necessarily a most powerful influence on the chances of recovery. The state of the kidneys, more especially, is of great importance in this respect; for no condition tends more certainly to a fatal termination, than a chronically diseased state of those organs. The result of amputations is also necessarily widely different, according as the operation is practised on the healthy inhabitant of a country district, or on the cachectic and debilitated denizen of a large town. The causes of death also differ in these cases. In the country, hemorrhage or acute inflammation; in towns, exhaustion, erysipelatous diseases, and pyemia, commonly lead to the fatal result.

3. The *Hygienic Conditions* that surround the patient after the operation exercise perhaps an equally important influence, not only on the rate of mortality, but on the cause of death. Exposure to an impure atmosphere, want of bad quality of food after an amputation, lessen materially the prospect of recovery, by disposing the patient to the worst forms of erysipelas, pyemia, and hospital gangrene.

β. The circumstances connected with the operation itself that influence materially its result, are, 1. The *Seat* of the amputation. 2. The *Structure of the Bone* sawn. 3. Whether the operation is done for *Injury* or *Disease*. 4. If for disease, the *Nature* of the affection. 5. If for injury, the *Time* that has elapsed before the limb is removed.

1. With regard to the influence of the *Seat* of amputation on the result of the operation, it may be stated as a general rule, that the risk is greater in proportion as the size of the part that is amputated increases, and as the *line of amputation* approaches the trunk; in fact, the nearer it is to the trunk, the greater is the danger. In the larger limbs, more especially in the thigh,

Of these amputations, 66 occurred in the Hospital up to 1841, and are reported by Mr. Potter in a paper published in the *Medico-Chirurgical Transactions* for that year. They were performed by the several surgeons of the Institution at that time. Of the remaining 160, 41 were performed by Mr. Liston, between 1841 and his death in 1847; 5 by his immediate successors; and 114 by me.

Malgaigne's statistics from the Parisian hospitals illustrate this matter in an equally clear point of view, as will be seen in the following tables.

SITAT	Injury.			Disease.		
	CASES	DEATHS	PER CENT.	CASES	DEATHS	PER CENT
Thigh	48	34	74	153	92	60
Leg	79	60	83.3	112	55	49
Foot	9	6	66.6	29	3	10.3
Arm	30	17	56.6	61	4	6.5

The following table gives the results of cases occurring in the London and provincial hospitals for three years, as published in the *Medical Times*.

SITAT	Injury.			Disease.		
	CASES	DEATHS	PER CENT	CASES	DEATHS	PER CENT
Thigh	90	55	61	303	71	23.4
Leg	310	44	40	137	35	25.5

The shock inflicted by the injury, with its subsequent evils, appears to be one of the principal reasons of the greater frequency of the mortality after amputations for injury than of those for disease. After amputation for injury, also, there is a greater liability to the occurrence of gangrene of the stump, and pyæmia and its secondary effects, than in the case of the removal of a limb for disease; in which the principal causes of death usually appear to be exhaustion, and the supervention of disease of the lungs. In amputation in cases of disease, it will be found that those patients do best in whom the disease is most chronic. This is especially observable in cases of disease of bones and of the joints.

4. The *Nature of the Disease* for which the amputation is performed influences its mortality. Thus, amputations for malignant disease are more fatal than those for caries of bone or diseased joints. In cases of diseased joint, there is a greater tendency to recover when the affection is of a simple than when it is of a tuberculous nature. When suppurative disorganisation of a joint is very acute, amputation, more particularly if the affected articulation be of large size, as the knee, is attended by very unfavourable results. The tendency to pyæmia is especially strong in such cases, the blood being loaded with effete materials, the products of the inflammatory action, which are specially apt to run into suppuration, both in it and in the tissues generally. But when the disease has once become chronic, the precise period at which the amputation is performed exercises but little influence on the mortality, provided it be not deferred to too late a stage, when the patient's constitution is worn out by hectic.

Amputations of expediency—those performed for the convenience of

limb, calling those amputations *intermediate* that are performed between these two periods, viz., from the twenty-fourth hour to the occurrence of suppuration, and which consequently occupy a very extensive range. I think, however, that this distinction is a somewhat trivial one, and not very easily applied in practice; and it is better to include under the term *secondary*, all amputations performed after inflammatory action has been set up in the injured part. In civil practice, the mortality after primary amputations, as will be seen by the preceding table, somewhat exceeds that following secondary operations. It is more especially primary amputations of the lower extremities, and particularly those of the thigh, that are attended by very fatal results. Of the 46 cases of primary amputation of the thigh, recorded by Malgaigne, 34 perished. And of 24 cases recorded by South, Laurie, and Peacock, as occurring at St. Thomas's Hospital, the Glasgow Infirmary, and the Edinburgh Infirmary, every one proved fatal. This similarity of result, occurring in different institutions, shows clearly that the operation is one of the most fatal in surgery, and that the great mortality attending it is inherent to it, and not dependent upon local or accidental circumstances. This danger of amputation of the thigh for injury is increased in proportion as the limb is severed high up. It is least in those cases in which the operation is done for injury of the leg or knee-joint, and greatest when it is performed for compound fracture of the femur, recovery from which is rare indeed.

In military practice the case is different: secondary amputations being by far more fatal than primary. This has been the experience of army surgeons from the time of Faure, Larrey, and the Peninsular officers, to those of the late Crimean campaign. Thus, Faure saved only 30 out of 300 secondary amputations, whilst Larrey saved three-fourths of those in which he amputated primarily. In the Peninsular war, the mortality after secondary amputation of the upper extremity was twelve times, and after secondary amputation of the lower limb, three times, as great as after primary amputation of these parts. In the British army in the Crimea, from the 1st of April to the close of the war, the relative rate of mortality per cent., after primary and secondary amputations, was as follows:—

After *primary* amputations at the shoulder, 27; of the arm, 17; of the fore-arm, 3; of the thigh, 62; of the leg, 30; and of the foot, 17.

After *secondary* amputations the deaths per cent. were,—at the shoulder, 66; of the arm, 31; of the fore-arm, 28; of the thigh, 80; and of the leg, 76. Or, for the upper extremity, the whole rate of deaths after primary was 15, against 41 after secondary amputations; whilst, for the lower extremity, excluding the foot, it was 46 for the primary, against 78 per cent. for the secondary.

To what is this difference between the results of primary and secondary amputations in civil and military practice owing? Why are the results of amputations reversed in civil and military practice? Why are primary amputations more fatal in civil, and secondary amputations in military, practice? I think we may explain this difference in respect to primary amputations, partly by the circumstances under which the injury of the limb has been received, and partly by the difference in the nature of the accident. As has already been stated, the shock to the system is the main cause of death after primary amputations, and this is felt less severely by the soldier than by the civilian. A soldier struck in the heat of action, when his spirits are raised, and his courage is high, treats his wound almost with indifference, or looks upon it, perhaps, as a glorious accident of his profession; whilst the civilian, whose limb is crushed by the wheel of a

This may usually most readily be done without amputation, by making an incision through the pulp of the finger, and then extracting the diseased



Fig. 8.—Amputation of a Finger.

bone, thus saving the nail and pulp, which will form an excellent end to the finger. Yet, in other cases amputation will be required. This may either be done by cutting into the joint from its dorsal aspect with a narrow-bladed bistoury, running across it lightly, touching the lateral ligaments, and making the flap from the palmar aspect; or the flap may conveniently be made from the palmar surface by transfixion, and then cutting

across the joint (Fig. 9).^{*} In doing this, care must be taken not to cut too far backwards, and to mistake the depression above the head of the second phalanx for the articulation, which would lead to a little embarrassment. Some little difficulty is occasionally experienced in finding the joint, and surgeons have endeavoured to be guided to it by attention to the folds in the integument covering it; but in these there is no constancy, and no correlation exists between the joint and the folds in the skin over it. When the amputation is performed from the dorsal aspect the finger should be flexed, when the joint will be found immediately under the apex of the triangle formed by the phalanges. In operating from the palmar aspect, the finger should be forcibly extended as soon as the flap is made, when, if the knife be applied to the lateral ligaments, the synovial surface will show itself.



Fig. 10.—Amputation at Metacarpophalangeal Joint.

Amputation is frequently required at the *Metacarpophalangeal Articulations*. Here it may be done in two ways: either by lateral flaps, or by the oval method. If by *lateral flaps*, the adjoining fingers should be well separated from the one about to be removed, by an assistant who grasps the hand, so as to put the integument on the dorsum upon the stretch. The point of a bistoury should then be entered about three-quarters of an inch

Amputation is performed between the proximal and second phalanges in the same way; but, as a general rule, it should not be done here; because, as no flexor tendon is attached to the proximal phalanx, it is apt to remain permanently extended, and a good deal in the patient's way. In the case of the index finger, however, it will be better to leave the proximal phalanx, the stump of which forms an useful opponent to the thumb.

^{*} For the *Conservative Surgery of the Hand*, vide Chapter xlviii.

at the head of the metacarpal bone; it is then carried forwards to a point opposite the interdigital web, drawn across the side of the finger, and then carried a little way into the palm. The same process is performed upon the opposite side, the flaps are dissected down by a few touches of the knife, the extensor tendon is divided, the joint opened, and disarticulation performed. The *oval method*, which I think is the best, as it does not wound the palm, consists in entering the bistoury at the same point as in the last case, carrying it as far as the web, drawing it across the palmar aspect of the finger, and then obliquely backwards to join the starting-point of the incision. By a few touches of the point of the knife the oval flap is turned back, and the articulation opened. As a general rule, it is better to remove the head of the metacarpal bone, together with the finger; as otherwise a wide gap will be left in the situation of the finger that has been amputated, and much deformity of the hand result. This may be done by cutting the metacarpal bone across beyond its head with bone-forceps in a transverse direction, if it be either the middle or ring finger that is removed (Fig. 10). If it be the index or little finger, the bone should be cut obliquely from without inwards, so as to shape it to the tapering form of the hand (Fig. 11). If it be cut directly across, an ugly and inconvenient square protuberance, liable to constant injury, will be left. In some employments, however, in which great strength and breadth of hand are required,



Fig. 11 — Amputation of Index Finger.

may be cut directly across, an ugly and inconvenient square protuberance, liable to constant injury, will be left. In some employments, however, in which great strength and breadth of hand are required,



Figs. 12, 13, and 14 — Results of Amputation at Metacarpophalangeal Articulation.

and when appearance is of little consequence, the head of the bone may unnecessarily remain.

The after-treatment of these cases is extremely simple. The hand should be put upon a splint, the wound covered with a piece of water-dressing, and the ends of the fingers, with small pieces of lint interposed, tied together by means of a tape, care being taken, however, that they do not overlap. The shift of the metacarpal bone that is left will gradually atrophy, and thus a very taper and shapely hand eventually be left (Figs. 12, 13, 14).

In disease or injury of the *Thumb* as little as possible should be removed by amputation; for, if even but a very short stump of the metacarpal bone is left, it will serve as an useful opponent for the other fingers. When the thumb requires amputation, it may most conveniently be removed by Liston's method. The point of a long narrow bistoury should be introduced well on the palmar aspect of the carpo-metacarpal articulation, carried over this, which it opens (Fig. 15), and the dorsum of the hand as far as the web; the point of the knife should then be pushed downwards through the ball of the thumb, transfixing this and issuing where the incision commenced.



Figs. 15, 16, and 17. — Amputation of the Thumb.

It is next made to cut outwards, keeping close to the metacarpal bone, which is readily twisted out, the remaining attachment being separated by a few touches of the knife. An oval incision will be left, which comes together closely by a narrow line of cicatrix. In amputating the right thumb, it will be necessary for the surgeon, if he adopt the method just described, either to use his left hand, or to cross his hands in an awkward manner. In order to avoid doing this, he may reverse the steps of the operation with advantage; first transfixing the ball, and making the anterior flap, then cutting over the dorsum, opening the joint, and turning out the bone (Fig. 16). Fig. 17 represents the hand after amputation of the thumb.

The *Metacarpal Bones*, with or without the fingers supported by them, occasionally require removal for disease or injury. For these operations, which are not of a very regular kind, it is difficult to lay down definite rules, in performing them, care should be taken to make good square flaps of sufficient size, but to avoid cutting into the palm if possible. It is well not to disarticulate the lower end of the bone, so as to open the wrist-joint, but rather to cut it off with bone-forceps a little above this. In injuries from the explosion of powder-flasks or gun-barrels, when the hand is much shattered, it is of great consequence to avoid cutting up the palm

it commenced, and the flap thus made must be dissected back. The palmar flap is next made by transfixion (Fig. 21). As soon as it is cut, the bones

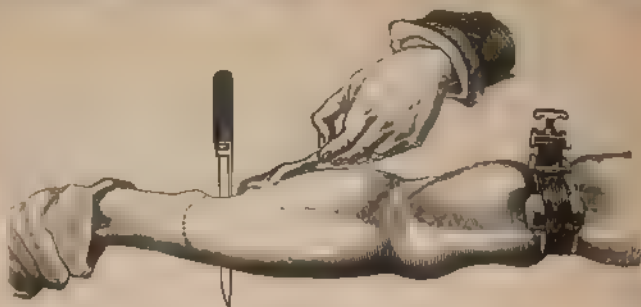


Fig. 21 - Amputation of the Fore-arm.

are cleared by a couple of sweeps of the knife, and the interosseous membrane is divided; they are then sawn together. The vessels are cut long at the end, and on each side of the palmar flap.

Amputation of the Arm is most readily performed by lateral flaps made by transfixion from before backwards; the bone is then well cleared by a couple of sweeps of the knife, and sawn across. In clearing the bone, care must be taken fairly to divide the musculo-spiral nerve by a firm sweep of the knife round the back of the bone (Fig. 22), if the amputation be performed in that part of the arm where this nerve winds round the humerus. If the limb be very muscular, skin-flaps and the circular section of the muscles will probably give the best result.

Amputation at the Shoulder-joint may be required for injury of the arm or disease of the humerus; in the first case it is best performed by transfixion; in the other, by cutting from without in-

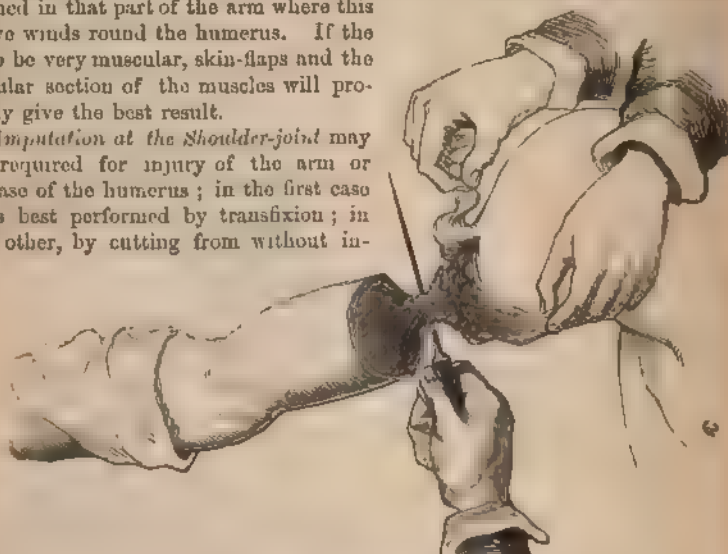


Fig. 22.—Amputation of the Arm.

wards. The subclavian artery should be compressed as it passes over the first rib; though, if the assistant be steady and well acquainted with his duties, this may be dispensed with.

In operating by transfixion, a long narrow-bladed knife should be used. One assistant must have charge of the limb; another should raise the flap; and a third must follow the knife as it cuts behind the humerus, and grasp the posterior flap with the axillary artery, so as to prevent hemorrhage from

action of the bone cannot be put in force, and it is sometimes not such an easy matter as might at first appear, to detach its head from the glenoid cavity. In order to do this, I have in cases of comminuted fracture of the humerus, in which I was amputating at the shoulder-joint, found it necessary, after opening the capsule, to seize hold of the upper fragment and to draw it forcibly downwards and inwards, by inserting the fingers between the head and the glenoid cavity, in order to divide the muscles inserted into it. After the head of the bone has been turned out of the glenoid cavity, the knife must be passed behind it, and carried down for a distance of about three inches close to the bone at its inner side. The surgeon then cuts across the soft parts, so as to form the posterior flap. In doing this, the assistant, to whom this part is entrusted, must follow the knife with his hands, grasping firmly the whole thickness of the posterior flap, so as to compress the axillary artery, and thus prevent the occurrence of hemorrhage (Fig. 24). The surgeon should not cut the flap across until the assistant tells him that he holds the vessel firmly, and then he must be cautious not



Fig. 25. Stump after Amputation at Shoulder-joint.

to injure his assistant's fingers. The artery will be found to be cut long in the middle of the posterior flap, and a few smaller branches may be required to be tied at its inner angle and in the deltoid. The stump, after it is healed, will present the appearance shown in Fig. 25.

In those cases in which this operation requires to be performed for disease, especially for tumours of the humerus, by which the soft parts are thinned or condensed, it may very conveniently be done by making the anterior flap by dissecting it up from without inwards, using of course for this purpose a short knife; a broad bistoury is most convenient. The joint is then opened, and the posterior flap formed in the usual way. In this way I have easily performed amputation at the shoulder-joint for large tumours of the head of the humerus.

General Results of Amputations of the Upper Limb.—Amputations of the upper extremity are, upon the whole, extremely successful. In the Crimea, amputations of the fore-arm were fatal in the ratio of 7, and those of the arm of 19, per cent. At Guy's Hospital, Mr. Bryant states that traumatic amputations of the fore-arm were fatal in the ratio of 16, and those of the upper arm of 22, per cent. At University College, in Mr. Liston's and my practice, of 9 traumatic amputations of the upper arm, there were three deaths; whilst of 7 in which the fore-arm was removed, all recovered. The cause of death is usually pyæmia, erysipelas, or congestive pneumonia.

Amputations of the fore-arm and arm for disease, more particularly for strumous affections of the bones and joints, are amongst the most successful operations in surgery. When they are done for malignant disease, the risk is greater.

Amputation at the shoulder-joint for injury, although necessarily more fatal, is very successful for so severe a procedure. In the Crimea, the mortality amounted to 35 per cent. At University College I have done it four times, with one fatal result. When this operation proves fatal, the

of the joint, he opens the articulation and detaches the bone by lightly touching its ligamentous attachments. By keeping the edge of the knife well against the side of the bone, he may avoid wounding the dorsal artery of the foot, the bleeding from which would be troublesome. When the bone is to be partially removed, the operation must be performed in the same way; the incisions, however, not being carried so far backwards.

The *Metatarsal Bone of the Little Toe* may conveniently be removed by



Fig 28 — Removal of Metatarsal Bone of Little Toe.

an oval incision, so as to avoid wounding the sole of the foot. This is best done by entering the point of the knife just behind the tubercle of the

bone, carrying it forwards and inwards in the line of its articulation with the cuboid, to the centre of the fourth digital interspace, and thence forwards to the web of the toe; the knife is next carried round the plantar surface of this, the incision being continued obliquely into that which has been made on the dorsum of the foot (Fig. 28). The small flap thus formed is well dissected down, the knife passed round the under surface of the bone, and the joint opened by the toe being forcibly drawn outwards, and its ligamentous connection lightly divided.

The *whole of the Metatarsal Bones* may be removed from the tarsal, by the operation originally planned and executed by Mr. Hey. This consists in, first of all, making a large convex flap in the sole of the foot, one horn of which commences at the tubercle of the fifth metatarsal bone, whilst the other terminates at that of the first, or rather opposite the projection of the scaphoid. A small flap is then made on the dorsum of the foot, and the



Fig 29 — Tarsal-Metatarsal Joint

articulations are exposed. These must then be opened with some care, as they are very irregular (Fig. 29); the second metatarsal bone, especially, being sunk into a kind of pit in the middle cuneiform, and the articulation of the fifth with the cuboid being very oblique. This operation is seldom practised, disease being rarely limited to the metatarsal bones, but usually implicating the joints as well. Their disarticulation also from the tarsus is very troublesome, on account of the irregularity of the line of articulation; hence it is better to saw through the metatarsus just in front of the

tarsal articulations, than to attempt to disjunct the bones. A combination of these two procedures may sometimes be advantageously adopted. In one of those severe crushes of the anterior part of the foot, that are not unfrequently the result of railway injury, and in which the bones and soft parts are irregularly crushed and torn, I made a very excellent stump by disarticulating the first and the fifth metatarsal bones, and sawing across the three middle ones almost an inch anterior to their articulations with the tarsus.

Amputation through the Tarsus may conveniently be performed by

between it and the cuneiform bones. After disarticulation has been produced, the projecting head of the astragalus and the articular surface of the cuboid should be sawn off. In more than one instance, I have found firm osseous ankylosis existing in the line of articulations, so as to require the use of the saw for the separation of the anterior part of the foot. The result of this operation is extremely favourable, the patient, by the aid of a properly constructed boot, being able to walk, and even dance, with very little appearance of lameness. In some cases, where the muscles of the calf are very strong, and the calcaneum projects, the heel becomes drawn up, and the centre edge of the stump made to point down in such a way that the patient is rendered lame by walking on the anterior sharp edge of the calcaneum, which irritates the flap. This condition is best removed by division of the tendo Achillis.

Disarticulation of the Foot at the Ankle-joint was first reduced by Mr.



Fig. 34.—Syme's Disarticulation at Ankle joint

Syme to a regular operation. By its performance amputation of the leg may often be avoided, the patient being left with an exceedingly useful stump, which, as its covering is ingeniously taken from the heel, constitutes an excellent basis of support (Fig. 37). The operation is performed by making an incision from the anterior part of one malleolus downwards and backwards, across the

plantar surface of the heel, to a corresponding point in the opposite malleolus (Fig. 34). This flap is well dissected back, the knife being kept close against the bone, especially when it passes towards the inner side



Fig. 35, 36. Syme's Operation



Fig. 37. Stump after Syme's Operation

of the os calcis, in the neighbourhood of the plantar arteries (Fig. 35). An incision is next made across the dorsum of the foot, from the upper extremity of the sole flap on one side, to that on the other, and the joint opened from the front (Fig. 34). The lateral ligaments should now be touched with the point of the bistoury, and the tendo Achillis divided by pressing the foot forcibly downwards and cutting from before backwards (Fig. 36); by some twisting and dissection, at the same time, the os calcis is completely separated from its soft attachments, and the foot removed; the

two nailrods must then be sawn off, the plantar arteries tied, and the flap brought up. A well formed rounded stump will thus be left (Fig. 37).

In performing this operation, care must be taken that no button-hole aperture be made through the posterior part of the heel flap. This may easily be avoided readily enough when the soft structures in this situation are greatly thickened and infiltrated by plastic matter, as the result of chronic disease; but, if the operation be required for injury of the foot, great care is required in digging out the heel, the integuments at the posterior part of the os calcis being very thin and adherent to the bone. It is also of importance that the incision across the heel should be carried well back over its point (Fig. 35). Unless this be done, a large cup-shaped flap will be left, in which blood and pus will accumulate, and the cicatrization of the stump will be much retarded. The principal point, however, to be attended to is, that the plantar arteries are cut long; unless care be taken to do this, the flap will be insufficiently supplied with blood, and sloughing, especially of its outer angle, to which there is in all cases a tendency, will be particularly liable to occur. As union takes place by granulation, there will be a tendency to bagging in the stump; but this may be prevented by proper bandaging. The tendency to sloughing and to undue suppuration chiefly occurs in those cases in which the amputation has been performed as a primary operation for a crush of the foot. In one case, in which I had occasion to perform it for an injury of this kind, a good deal of trouble resulted from this cause, though eventually the case did perfectly well, and the patient now walks with scarcely any difficulty. I look upon this operation as a most useful one in all cases requiring removal of the whole foot. The mortality attending it is, I believe, but small. I have performed it nine times without a fatal result or disagreeable consequence; and the stump, that a left admits of good pressure being exercised directly upon it without tenderness or fear of ulceration.

Various modifications of Syme's amputation may at times be practised with advantage, in consequence of the soft parts covering the heel being more or less altered or disorganised, so as not to admit of forming a good basis of support. Under these circumstances, the flaps may be fashioned from the sides instead of from behind; and in this way I have more than once formed an excellent covering to the end of the stump. These lateral flaps should not, however, be made in any case that admits of disarticulation at the ankle in the ordinary way. They never afford so good a basis of support as the integuments of the heel, which are far more dense and elastic.



Fig. 38.—Pirogoff's Operation.

Pirogoff's Modification of Syme's Operation consists in the preservation of the posterior portion of the os calcis, which is left in the heel-flap. The operation is performed in the

following way. An incision is carried across the sole of the foot from one malleolus to the other; the flap thus traced is dissected back for about two lines. Disarticulation of the astragalus is then effected in the usual way, by an incision across the front of the foot. A narrow amputating or a Butcher's saw is now applied to the upper and back part of the os calcis behind the astragalus (Fig. 38), and the bone cut obliquely downwards and well forwards; the malleoli are then removed, and a thin slice of the tibia with the articular cartilage taken off. After the operation, the opposed osseous surfaces must be accurately adjusted, the movable flap well supported by a broad strip of plaster, and the limb laid on the outer side, with the knee placed so as to take off the tension of the tendo Achillis. The advantages of this operation over the ordinary mode of disarticulation consist in the stump being longer, to the extent of the thickness of the portion of the os calcis left in it, and being better adapted for pressure; in the readiness of the union of the two apposed osseous surfaces; and in the less likelihood of the supply of blood to the posterior flap being interrupted, as its vascular communications are not much disturbed, and the plantar arteries can always be cut long. These advantages are not, however, always real, and are in some degree counterbalanced by the liability to recurrence of disease in the portion of the os calcis left in those cases in which the amputation is done for disease. When it is practised for injury, however, this objection does not hold good. Another objection, however, to this operation, consists in the section of two large osseous surfaces, exposing the patient to increased risk of osteo-phlebitis and pyæmia. In the first case in which I performed this amputation the patient, a healthy lad, whose foot was removed for injury, died from this cause.

The *Subastragloid Amputation* is another mode of disarticulating the foot. In it the heel-flap is made as in Syme's operation, and the articulation between the astragalus and scaphoid being opened (the ankle joint left intact), the bistoury is passed under the astragalus, between it and the calcaneum, which, together with the rest of the foot, is removed. In this amputation a good, long, useful stump results; but the cases requiring it must be few, as it does not often happen that the calcaneum, together with the anterior range of tarsal bones, is diseased, without the astragalus also being involved.

In cases of caries of the tarsus requiring amputation, it occasionally happens that the surgeon cannot determine with certainty whether the morbid action is limited to the anterior range of tarsal bones, or extends so far backwards as seriously to implicate the astragalus and calcaneum; and he is consequently unable to decide whether the foot admits of removal by Chopart's operation, or requires disarticulation at the ankle-joint. Under these circumstances all doubt will be cleared, and the proper operation performed, by making an incision across the dorsum of the foot in the line of the astragalo-scaphoid and calcaneo-cuboid articulations; these are then opened, and the state of the bones is examined. If the astragalus and calcaneum be sound, or but slightly diseased on their anterior aspect, Chopart's operation may be done, and any carious bone left behind gouged away. If, on the contrary, these bones be found to be deeply implicated, the flap may be dissected back for about an inch, and disarticulation at the ankle-joint proceeded with. It may also be well to bear in mind that the tarsal articulations may have become so ankylosed, as the result of old disease, as to require the application of the saw.

Results.—The amputation of a toe, of a metatarsal bone, or even of a

portion of the metatarsus, is but very seldom attended by fatal consequences. Should death occur, it is usually the result of an accidental attack of erysipelas, followed by pyæmia, to which any operation is liable. Disarticulation at the ankle-joint, though necessarily somewhat more dangerous, is yet one of the most successful operations in surgery, the mortality attending it being but very small. Of nine cases in which I have done it, not one has proved fatal.

AMPUTATION OF THE LEG may be performed in three situations: either just below the knee, in the middle, or in the lower third of the limb. The selection of the line of amputation must depend in a great degree upon the extent of the disease or injury, but, wherever practicable, the operation should be performed low down: the mortality diminishing in proportion as the limb is removed near to the ankle. Of 106 amputations in this situation done in Paris, there were only 13 deaths. Surgeons used formerly, even where the disease or injury was limited to the foot, to amputate immediately below the knee, in all those cases in which the patient would be obliged to wear a common wooden pin, the long leg stump being highly inconvenient when the patient rested on his bent knee; whereas in those individuals who could afford the expense of a well-constructed artificial limb, the amputation, when practicable, was done in the lower part of the leg. But this difficulty has of late years been removed by the introduction of a short wooden pin, in the socket of which the stump may be fixed in the extended position; and amputation in all admissible cases should consequently, even amongst the poorer classes, be done just below the calf, at the junction of the lower and middle thirds of the limb; nearer the ankle than this, it is not easy to get a good covering for the bones.

Flap Amputation of the Leg may be performed in the following way.

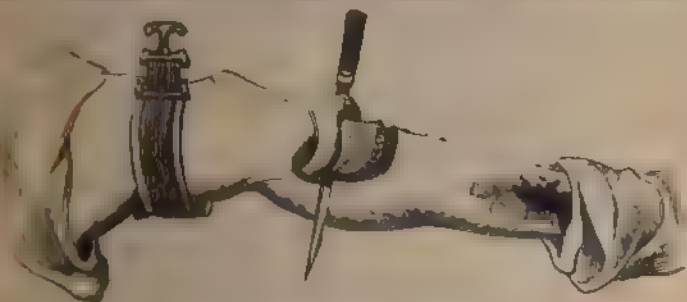


Fig. 39.—Flap Amputation of the Leg.

The tourniquet having been applied to the artery in the popliteal space (Fig. 39), the assistant, whose duty it is to retract the flap, takes his stand on the left, as in all amputations of the lower extremities, opposite to the surgeon. In the left limb, the point of the knife is entered at the posterior edge of the tibia, carried forwards for a distance of one inch and a half, then across the anterior part of the leg to the posterior border of the fibula, up which the incision is made to extend to a corresponding distance. In the right leg, the same incision commences on the fibular side of the limb, and terminates on the tibial. The flap thus formed, which should be broad and well rounded, is next dissected up by a few touches of the point of the knife, and transfexion of the limb is made by passing the blade across behind the bones, from one angle of the incision to the other (Fig. 39). The posterior flap is then formed by cutting obliquely downwards and backwards,

and should be about three inches long. The bones are next cleared by a double sweep of the knife, and the interosseous soft parts divided by carrying the instrument in a figure-of-8 way between the bones. In doing this, especial care must be taken not to direct the edge upwards, so as to split either of the tibial arteries, more particularly the anterior: for, as this vessel retracts above the menbrane, its ligation, when divided too high, is no easy matter. If the amputation have been performed just below the knee, it is possible that the popliteal trunk may be divided before its bifurcation, and thus one artery only require the ligature. In sawing the bones, the fibula should always be cut first, as otherwise it will be pretty sure to be splintered. This bone may be best divided on the left side, by sinking the hand below its level of the limb, and using the heel of the saw; and on the right, by holding the hand above the limb, and cutting with the end of the



Fig. 40.—Amputation of the Leg. Sawing the Bone.

instrument (Fig. 40). After the removal of the limb, the sharp anterior edge of the tibia may advantageously be sliced off obliquely, so as to lessen the risk of sloughing of the corresponding flap from pressure upon a sharp ridge of bone.

If the limb be very muscular, a large pad of the muscles of the calf will be left in the posterior flap; this will usually be a good deal in the way during treatment; it may slough, and thus interfere with proper union. In some cases, I have advantageously removed at one sweep of the knife the greater part of the muscular mass thus left, thus leaving little more than a skin flap; but, in order to avoid this, the best operation consists, in such cases as these, in forming skin-flaps on the anterior and posterior aspects of the limb, and then making a circular cut through the muscles. In this way the ends of the bones receive but a thin covering; but this matters little if the operation be performed just below the knee, for the patient, bearing upon the anterior face of the stump, exercises no pressure upon its cicatrix when an artificial limb is adapted to it.

Results.—Amputation of the leg may, upon the whole, be looked upon as a successful operation. The mortality, however, varies not only according to the situation at which the limb is removed, but also according as it is done for injury or disease, and the nature of that disease. So far as

great. The limb being removed at a greater distance from the trunk, the shock to the system will be less, and the rate of mortality diminished; the medullary canal of the femur not being opened, there will be less likelihood of osteomyelitis; fewer ligatures will be required, and, if a long posterior flap have been made, these may be brought out through an opening made in the centre of it, as Blandin recommends; and lastly, a longer stump will be left, the movements of which will be more under the control of the patient than a shorter one, owing to the proper muscles of the femur not being divided, and all the movements of that bone being thus preserved in their integrity. There is a little point of practice that I have found useful in this amputation; viz., to round off with the saw the sharp edge left on the condyle after the removal of its cartilaginous surface, which otherwise may press injuriously upon the flap.

Results of Amputation through Knee-joint or Condyles of the Femur.—So far as life is concerned, these operations have been successful. Dr. Markoe finds that of 49 cases in which amputation through the knee has been practised, there have been 17 deaths,—a rate of mortality equal to only 37 per cent. The statistics of amputation through the condyles of the femur immediately above the joint have not been made out.

These amputations present three great advantages. 1. As the medullary canal of the femur is not opened, the patient is saved all that risk which results from suppuration within that canal, the infiltration of pus into it, and the consequent liability to suppurative phlebitis of the veins of the bone, and consecutive pyemia. 2. He is provided with a long thigh stump, which gives increased leverage in using an artificial limb. 3. When the amputation is practised with the long anterior flap containing the patella, the end of the stump will be protected by the dense and tough integumental and aponeurotic structures naturally situated in front of the knee-joint, which admit of pressure being made upon them without fear of excoriation: the cicatrix being drawn up behind the end of the stump, and altogether away from its surface.

AMPUTATIONS OF THE THIGH are commonly required both for accident and for disease. They may be performed in three situations: immediately above the knee, in the middle of the limb, or in its upper third. In the amputation in the lower or middle third, a tourniquet may be applied high on the limb; but when the operation is done in the upper third, there is no space for the application of this instrument, and the surgeon must then trust to an assistant compressing the artery as it passes over the brim of the pelvis.



Fig. 42.—Amputation of the Thigh. Worme's Operation.

Compression is best made by grasping the great trochanter with the fingers

gaping fleshy stumps are avoided, which commonly run into unhealthy suppuration and sloughing, leading to the death of the patient.

Amputation through the Trochanters may sometimes be advantageously practised, either in severe compound fractures of the lower part of the thigh, or in cases of malignant cartilaginous or osseous tumours of the lower and middle third of the femur; and thus the more severe and dangerous operation of disarticulation at the hip may be avoided. Indeed, should it be found, after section of the bone, that it is so much injured or diseased as to require removal at the joint, this may readily enough be done by dissecting the head out of the acetabulum with a strong scalpel or bistoury.

Results.—The mortality after amputation of the thigh is very considerable when the operation is done for injury, more particularly for compound fracture of the femur itself. The statistics of the operation have already been given at pp. 31 and 32; I need not therefore repeat them here. It is a remarkable circumstance, that in some hospitals primary amputation of the thigh seems almost invariably to have been a fatal procedure; whilst in other institutions the mortality has not exceeded 50 or 60 per cent. At Guy's and at University College, secondary amputation of the thigh has been more fatal than the primary.

The result of amputation of the thigh for disease of the knee-joint depends entirely upon whether the affection is acute or chronic. In acute suppurative disorganisation of the knee, amputation of the thigh is most fatal; indeed, so high is the rate of mortality, that it is doubtful whether it is proper to perform the operation in that stage of the affection. In chronic knee-joint disease, on the other hand, the operation is most satisfactory and successful; death seldom resulting unless it have been deferred to the last stage of exhaustion.

The causes of death vary according to the condition for which the operation is performed. In primary traumatic amputation, the fatal event is chiefly brought about by exhaustion, traumatic gangrene of the stump, or secondary hemorrhage. In secondary amputations, and in those for disease, pyæmia, erysipelas, and exhaustion are the usual causes of death.

AMPUTATION AT THE HIP-JOINT has been performed in a variety of ways, which it is not necessary to detail. The simplest and speediest consists in making a large and thick anterior flap by transfixion, and a short posterior one from the gluteal region and back part of the thigh. In order to perform this operation properly, the patient's body must be brought well forward upon the edge of the table, so that the nates project beyond it, and the sound limb tied to the leg of the table. One assistant, whose duty it is to raise the anterior flap and compress the arteries as they are cut, should stand behind the surgeon; another must have charge of the limb, and impress such movements on it as to bring the head of the femur into the best position for the proper performance of the operation. The duties of both these assistants are of the utmost importance, and should be intrusted only to fully competent persons. The pelvis and body must be well steadied by two or three others. The knife, which must have a blade twelve inches long, requires to be entered, and the flap to be made, in different ways, according to the side of the body on which the operation is performed. If it be on the left side, the knife should be entered about two fingers' breadth below the anterior superior spine of the ilium, and carried deeply in the limb behind the vessels, directly across the joint; its point being made to issue just above the tuberosity of the ischium (Fig. 45). In transfixing, care must be taken not to carry the point of the knife too high, lest it enter the thyroid foramen. The anterior flap must then be rapidly cut downwards

In amputation at the hip-joint, the great immediate danger to be apprehended is excessive hemorrhage, the incisions being made so high up that no ordinary tourniquet can be applied. By means of Lister's compressor, the circulation through the abdominal aorta may be arrested, and thus the danger obviated. It is of great importance to perform the operation with as much rapidity as possible, and the disarticulation ought to be effected in at most thirty or forty seconds; and it may be done in much less time than this. The arrest of the hemorrhage during the operation must be intrusted to an assistant who can be fully relied on. After the abdominal compressor has been applied, and the flow of blood through the aorta arrested, his business should be to compress the artery above the brim of the pelvis, and then to follow the knife in the first incision, and, as the anterior flap is being made, slip his fingers under it and grasp it firmly above and below, so as to compress the femoral artery in it, which is divided as the knife cuts its way out (Fig. 47). By grasping the flap tightly, there will be but little risk of



Fig. 47.—Amputation at Hip-joint: Compression of Femoral Artery in Anterior Flap.

hemorrhage from the femoral artery, even when the abdominal artery has not been compressed by the application of the tourniquet; but lest this should slip, or the assistant whose duty it is to grasp the flap by any chance should fail in holding it properly, it may be well to direct one of the assistants, whose business it is to steady the trunk, to have his thumb well pressed down into the iliac fossa, so as to compress the artery against the brim of the pelvis. As the posterior flap is being made, the bleeding from the gluteal and sciatic vessels, which is often very free, may be arrested by two assistants who should be ready to cover and compress them with the fingers or sponges. The arteries may then be ligatured one by one, as the assistant raises his fingers from them. If he have good hold of the femoral, the vessels in the posterior flap may be tied first; but if the femoral be insecurely held, it must be first tied. The femoral arteries, both superficial and deep, will be found to be cut long, and to project from the muscles by which they

attended with uneasiness. The temperature is never above, but often below, the natural standard, and the functions are lessened in activity.

The existence of congestion in an internal organ may be ascertained by finding its size increased, its functions modified, with a sensation of weight in it.

EFFECTS OF CONGESTION.—These are of much surgical importance. The first change that usually takes place is an effort in the vessels of the part to relieve themselves, by a transudation of the more watery constituents of the blood into the surrounding cellular tissue. Hence distension of the interspaces of this tissue by the effused fluid, giving rise to *oedema*.

If the turgidity of the vessels be great, and their walls at the same time weakened, rupture will occur, and hemorrhage to the surface, or into the substance of the part, will ensue.

In consequence of the infiltration of the cells of the part, softening takes place, nutrition becomes less and less perfectly performed, and ulceration at last occurs. These changes we not unfrequently see in the integuments of the legs of old people. In other cases, the vessels becoming permanently dilated, the part assumes habitually a redder or darker tint, becomes swollen, and, if it be a mucous surface, it may be roughened and papillated, as is often observed in a congested conjunctiva.

CAUSES.—The causes of congestion, always mechanical, may be divided into two great classes, which we often find conjoined: 1. Those causes that act by obstructing the return of the venous blood; 2. Those that act by enfeebling the walls of the capillaries and veins, so that they are no longer able to withstand the outward pressure of the contained blood.

1. Amongst the first set of causes, may be specified any condition that directly and immediately interferes with the proper return of blood through a vein; in this way the pressure of a tumour upon such a vessel produces congestion of the part from which it carries off the blood.

Venous obstruction does not always act in so direct a manner as this; for it not unfrequently happens, that obstruction to the return of blood from one organ will occasion a congestive condition of the vessels in a distant one. Thus we find that some forms of congestion of the eye-ball are due to obstructions in the branches of the portal veins.

The long continued dependent position of a part may occasion its congestion by the blood mechanically gravitating into it, and overcoming, by the pressure thus brought to bear upon the vessels, the onward movement of the fluid within them. Thus we see congestion of the legs from long-continued standing; of the hemorrhoidal veins from an habitually sedentary life; and of the posterior part of the lungs of those who have been long confined to the recumbent position.

2. Amongst the most common causes of congestion that act by enfeebling the vessels, we find the debility of old age, acting partly by lessening the tone of the vascular system generally, and partly by inducing a diminution of the propulsive power of the heart. So also cold, by lessening the vitality and retarding the circulation of a part, produces congestion of it. Certain typhoid, or adynamic states of the system, favour the occurrence of congestion in the more dependent parts. And lastly, inflammation may terminate in this condition.

The obstructive causes are especially apt to induce congestion when they occur in connection with a feeble condition of the vascular system.

TREATMENT.—The treatment of congestion has strict reference to its cause.

The first indication consists in the removal of any source of obstruction to the return of blood from the part, as by unloosening a ligature, or elevating

those symptoms that characterise inflammation in its milder forms, but in a minor degree and of a less persistent character.

EFFECTS.—The effects of determination, when acute, consist either of rupture of the affected vessels, and a natural relief by the hemorrhage which ensues, as may happen in piles after a dose of aloes has been given; or, in the pouring forth of the secretions of the part, if a free surface or gland, considerably augmented in quantity and deviating somewhat perhaps from their normal character, as in lachrymation after the introduction of a grain of snuff into the eye. When this occurs within shut serous sacs, dropsical accumulations may ensue.

The more remote effects of chronic determination of blood to a part consist in permanently increasing its nutritive activity, and thus leading to induration and hypertrophy. Or, determination of blood may result in true inflammation.

CAUSES.—The causes of determination of blood are threefold.

First, an external irritant directly applied to a part will induce it, as when a grain of dust is blown upon the conjunctiva. Secondly, internal irritation, as an increased use of a part, will determine an increased flow of blood to it. Thus, using the eyes much in microscopical investigations may produce redness, watering, and irritation of those organs. To this class of causes may be referred the various forms of normal determination. The last class of causes consists in the repercussion of blood from one part to another.

Treatment of determination of blood is nearly identical with that of the milder forms of inflammation; hence we shall reserve the consideration of it until we come to treat of that disease.

INFLAMMATION.

The study of the inflammatory process is one of the most complex and difficult on which the surgeon can enter; but the labour required to master its details is well bestowed, inasmuch as an acquaintance with its nature, symptoms, and progress, gives an insight into a greater part of the science of surgery. The management of inflammation as it affects different tissues and organs, and thus constitutes distinct diseases, comprises a great part of the duties of a surgeon. The theory of inflammation is a purely physiological and pathological study, and, however interesting its investigation may be, yet, as the discussion of this subject belongs rather to the domain of general pathology than to that of practical surgery, it cannot consistently be entered upon here; but, regarding the subject from a surgical rather than from a physiological or pathological point of view, we must discard all hypothesis and confine ourselves to the results of trustworthy observation.

PHENOMENA.—In congestion the quantity of blood is increased, but the rate of its motion is lessened; in determination we have everything augmented: there is an increased size of the vessels, and an increased quantity of blood within them, circulating through them with increased velocity. In inflammation we have a combination of these conditions; we have an increased size of the vessels, an increase in the quantity and rapidity of the motion of the blood, but conjoined with this we have a tendency to its arrest, to its stagnation at points. In studying the phenomena of inflammation in the web of the frog's foot under the microscope, we observe that the first change on the application of a stimulus is the momentary contraction followed by dilatation of the artery; the flow of blood through it and the capillaries is at first accelerated; retardation from congestion then ensues; and lastly, stagnation at points.

though none are in reality formed. It is in this way that the surface of the conjunctiva may in a few hours be brightly reddened, not by the formation of new vessels, but by dilatation and accumulation of blood in previously existing ones.

Besides this dilatation of the smaller vessels of the part, the arteries become elongated, tortuous, and waved, increasing in length as well as in diameter. The German pathologists—Kolliker, Hasse, and Bruch, whose views are confirmed by Paget and Wharton Jones—have observed that the arteries of the inflamed part have a tendency to become dilated at points, so as to present small varicose or aneurismal pouches projecting from their walls, or fusiform dilatations of their whole diameter. These changes would appear to arise from one of two causes: either that the vessel is constricted at points between which it maintains its normal width, and thus that the dilatation is apparent and not real; or, that it is actually dilated where it appears to be so.

I shall not enter upon the question as to the causes of these changes in the vessels; how a stimulant acts in giving rise to them, and what share the nerves of the part may have in their production; as these are points out of the scope of this work, and, indeed, appear as yet to be altogether undecided.

2. *Blood*.—The changes that the blood undergoes in inflammation are fully of as great importance as those presented by the vessels.

The most apparent physical change met with in this fluid is, that it appears to have become thinner, as was long ago pointed out by Hewson. But there are other changes that can only be appreciated by chemical and microscopical research, which Mr. Lister has shown to be similar to those changes that take place in the blood when separated from the living body. These we must study, as they affect the different constituents of the blood.

The *red particles* have been shown by Andral and Cavarret to be increased in quantity in the early stages of inflammation; but, as the disease continues, they speedily diminish in number, falling below the natural standard, as Wharton Jones and Simon have pointed out. No other apparent change takes place in these particles, except their increased adhesiveness and their tendency to aggregation into clusters by the cohesion of their flat surfaces. This clustering of the red particles, first pointed out by Wharton Jones, takes place in the vessels as well as out of them, and is considered by its discoverer, and by Henle, to be owing to inspissation of the plasma.

The *white corpuscles* have excited much attention of late years in connection with the arrest of circulation in inflammation. Dr. C. J. B. Williams has shown that they appear in increased numbers in the inflamed part, and by their adhesion to the walls of the vessels become one principal source of the arrest of the circulation. There are several questions, however, with reference to the white corpuscles:—1. As to their actual increase; 2. As to the cause of this increase in their numbers; and 3. As to their greater disposition to adhere to the vessels. Their increase in inflammation is stated by Wharton Jones to be partly relative, owing to the diminution in the red particles; and Paget, as well as other observers, is of opinion that it is only in sickly and young animals kept for the purpose of experiment that this increase has been observed, never being met with in healthy animals, or in the human blood taken from inflamed parts. Hence he infers that they are only met with in large numbers in inflammation, when existing *numerously elsewhere*. Their appearance in large numbers in the vessels of the *inflamed part*, and their accumulation here, is ascribed by Wharton Jones

that the tissues of an inflamed part approximate to the condition of dead matter, "or, in other words, have suffered a diminution of power to discharge the offices peculiar to them as components of the healthy animal frame."

SYMPTOMS OF INFLAMMATION.—These are *local* and *constitutional*. In order that they should occur, so as to establish the existence of the inflammatory process, it is necessary that the actions constituting it continue for some length of time; as they gradually pass from determination and congestion into inflammation, it is difficult to say, except by the persistence and intensity of the symptoms, that the physiological state has ended and the pathological one commenced.

The *Local Signs* of inflammation may be referred to five heads; viz., 1. *Alteration in Colour*; 2. *Alteration in Size*; 3. *Modification of Sensation*; 4. *Increase of Temperature*; and 5. *Modification of Function of the part affected*. Each of these conditions may separately occur, or two or more be associated together, without the existence of inflammation; but it is the peculiar grouping together of them all that characterises the presence of the pathological condition.

The relative intensity of these changes varies greatly, according to the tissue which is the seat of the inflammation; thus, in inflammation of mucous membranes and of the skin, the alteration in colour is most marked; in inflammation of the cellular tissue, the change in size always attracts special attention; and when a fibrous tissue is inflamed, its sensibility becomes greatly increased.

1. *Alteration in Colour* is an invariable and one of the earliest and most striking local signs of inflammation; parts that are naturally perfectly pale, as the ocular conjunctiva, assuming the most vivid crimson colour when inflamed. Some parts, though they change in colour, do not become red. Thus, the iris, when inflamed, assumes a greyish or brownish tinge; and the mucous membrane of the bladder, and of a portion of intestine, often becomes slate-coloured. The redness of inflammation varies from a bright crimson to a dull purple, the tint depending greatly upon the state of the constitution, and upon the presence of more or less congestion. The duller and darker the tint, the more local congestion or constitutional depression do we usually find. The redness is evidently due to the increased quantity of blood in the inflamed structure; and in the earlier stages of the disease, it is owing to the increase of the size of the vessels, the admission of new red corpuscles by which they are distended, and the draining away of the plasma. In some low or asthenic forms of the disease, the colouring matter of the blood appears to undergo changes that allow its ready transudation through the walls of the vessels; and in more chronic cases the vascularisation of the products of inflammation tends to render the coloration more permanent.

2. *Alteration in Size*.—Dilatation of the vessels being an essential element of the inflammatory process, swelling must be an invariable accompaniment of this disease. In the early stages this is due to the dilatation of the vessels; in the more advanced conditions, chiefly to the occurrence of effusions of various kinds.

The swelling varies greatly in different localities. It is greatest in those which are of a loose texture, and least in those which are firm and dense. Thus, for instance, in inflammation of the cellular tissue of the scrotum, the swelling is much greater than in the same disease affecting the testes. The inflammation of the conjunctiva occasions great swelling, that of the sclerotic but little.

The swelling of chronic inflammation may terminate in permanent hyper-

actual rise in temperature may be but trifling. This is owing to the exalted sensibility of the nerves.

The cause of the increase of temperature is interesting. In all processes in the economy in which determination of blood takes place, as in blushing or parturition, the temperature rises. This can clearly not be owing to any production of heat during respiration, which may account for the *general* heat of the blood, but not for its *local* increase. It is more probable that, as the ordinary and general supply of heat is derived from the waste of the tissues, so that of inflammation may be due to increased destruction of organic matters in the part inflamed.

5. *Modification of Function, Use, or Nutrition*, invariably occurs in inflammation, and furnishes important local symptoms. The *functional activity* of an organ is increased, in the earlier stages at least of inflammation; and the character of the secretions from the part is materially modified. Thus, when the mucous membrane of the urethra is inflamed, there is copious discharge from it; and this is not mucous, but purulent.

The *use* of the part affected is greatly interfered with; thus the bladder can contain no urine, the eye cannot bear the light, nor can a joint be moved, when inflamed.

The *nutrition* of the inflamed tissues is modified or arrested; hence, wasting, softening, or contraction, are common accompaniments of this process.

Constitutional Symptoms.—The severity of the constitutional symptoms will depend on the intensity and the extent of the inflammation; on the vital importance of the part affected by it; on the amount of local irritation; and on the origin of the inflammation from external or from internal causes. Thus, a moderate degree of inflammation in a part of no vital importance, as the skin, and occasioned by an external cause, as an abrasion, gives rise to no appreciable constitutional disturbance. But if the inflammation be wide-spread, as that of diffused erysipelas; or if it arise from constitutional causes; or if there be much local tension, as in whitlow; or if the part affected be of great importance, as the larynx or the eye, then the general symptoms become proportionally severe.

The constitutional disturbance in inflammation always assumes the form of fever—*Inflammatory or Symptomatic Fever*, or *Pyrexia*. Although the blood may previously have been in a diseased state, and so have predisposed the patient to the occurrence of an inflammation, the inflammatory fever is invariably secondary, being consecutive to the local affection. It is the true *surgical fever*, no febrile disturbance occurring in surgical practice except as a consequence of, and secondary to, local disease or injury. This fever appears to result primarily from deterioration of the blood, occasioned by the products of the rapid waste of the tissues that are the seat of the local disease—the inflammation—being poured into it more quickly than they can be eliminated by the different excretories of the system, and thus accumulating in the blood. This deteriorated blood becomes a source of irritation to the vascular and nervous systems; and the attempt at elimination of the effete matter with which it is charged, occasions congestion and disturbance of function of the different excretory organs. Andral states that increase of the fibrine of the blood in inflammation is the result of the waste of the tissues locally affected; that this is simultaneous with the accession of the fever; and that, when once this increase of fibrine has taken place, the spread and intensity of the inflammation are increased by it. He has further observed, that in inflammation without fever there is *no increase of fibrine*; and that, when the fever ceases, the proportion of

gradually merge into those types that are characterised by debility and irritation.

2. The *Asthenic* form of inflammatory fever principally occurs in those individuals whose constitutions are broken by privation, dissipation, or by any of the general depressing causes of disease, as grief, anxiety, or long residence in a vitiated atmosphere.

In constitutions such as these, so frequently met with in all classes, but especially amongst the poorer residents in large towns, inflammatory fever almost invariably assumes a low type. There is also, in this variety of the disease, a special tendency to its complication with visceral mischief; the lungs being peculiarly apt to become affected by a low or congestive form of pneumonia.

The asthenic form of the disease may come on as a sequence of the asthenic variety; the symptoms gradually merging into those of a low form, and being characterised by debility rather than by strength of action; the pulse becoming weaker though its frequency is kept up, the tongue becoming brown and dry, with a tendency to the early supervention of delirium of a muttering kind.

When the fever assumes the asthenic form from the very first, the period of depression is strongly marked, and often prolonged for many hours, reaction coming on gradually and imperfectly, alternating with the depression against which the system is struggling. Even when fully established, the symptoms of the stage of reaction are not of a very active character; there is throughout an appearance of heaviness or stupor about the patient, with little activity of the intellectual faculties, and an early tendency to delirium of a low form, especially at night; the pulse is feeble, though quick; the skin is either moderately hot, or else pungent and burning; the tongue brown and dry, with sordes rapidly accumulating about the lips and teeth; the cheeks are often flushed, and the eyes bright and staring. As the third stage comes on, if the patient recover, critical evacuations, often of a hemorrhagic or diarrhoeal character, appear; the pulse subsides, the tongue gradually and slowly cleans from the sides and tip, and the patient slowly and imperfectly regains his strength; the convalescence being often interrupted by intercurrent disease, and the powers of the constitution being frequently broken for months, or for life. If the disease take an unfavourable course, the weakness of pulse and dark incrustation of tongue increase; the skin becomes cold; hiccup, subsultus, dyspnoea, or coma supervene; and death occurs from exhaustion, or as the result of visceral complication.

3. The *Irritative* fever is of a less specific type. It is usually associated with the asthenic form, the nervous system being especially implicated. It occurs in individuals whose mental powers have been overwrought, or whose nervous systems have been irritated and shattered by intemperance. It is characterised by irregularity in its actions, by sudden exacerbations, and by a rapid decline. The several febrile symptoms run high in the early stages. The pulse soon becomes sharp and small; there are high delirium of a furious kind, wildness of eye, and heat of head. But these symptoms soon give way to signs of debility and exhaustion, and death takes place from coma and cerebral irritation.

TERMINATIONS OF INFLAMMATION.—There are two ways in which inflammation may terminate without leaving any traces of its presence in the part affected: these are by—1. *Resolution*, and 2. *Metastasis*.

1. The termination by *Resolution* simply means a return to health. The pain and heat first subside, the swelling lessens, and lastly the redness passes away; the constitutional symptoms also disappear. With regard to the more

In chronic inflammation we not unfrequently find that increased nutritive activity of the part leads to an increase in its size and growth, partly owing to actual augmentation in bulk of the tissues of the part; in many cases, however, being rather dependent on effusions into the cellular membrane.

Interstitial absorption and *gradual wasting* of a part, without previous softening, often occur as an effect of inflammation. Thus, a blow on the hip will occasion absorption and shortening of the neck of the femur.

Loss of transparency in structures that are normally translucent is a common effect of chronic inflammation, as may every day be observed in the cornea or in the capsule of the crystalline lens; in some cases this rather depends upon a modification of nutrition than upon the deposit of new matter upon the part. In other cases, again, it proceeds from the deposition of plastic matter in or upon it.

VARIETIES OF INFLAMMATION.—The symptoms, terminations, and effects of inflammation that have just been described, are those which characterise the more ordinary forms of the disease. In practice, however, we recognise many important varieties of this affection. These may be referred to three heads, as they affect its *Duration*, its *Intensity*, or its *Character*.

1. *Duration*.—The disease may be acute or chronic, varying from a few days to many years, being especially persistent in those structures that are naturally least vascular, as, for instance, bones and joints.

2. *Intensity*.—When the symptoms are well marked, the redness and heat great, the tension considerable, and perhaps the pain severe, with corresponding constitutional disturbance, the inflammation is said to be *active* or *acute*; when of a less intense character, it is termed *subacute*; and when there are merely redness and swelling, with little or no pain, and but slight constitutional disturbance, the disease is said to be of a *passive* kind. The duration of the inflammation commonly influences its intensity, which is usually less in the more chronic cases; but very frequently we find the reverse, and when of but short duration it may be subacute or passive, whereas some forms of a very chronic character may retain great activity, and are especially liable to recurrent active attacks.

3. *Character*.—If the inflammation be circumscribed, occurring in a healthy constitution, and tending after a moderate time to terminate in resolution, it is called *healthy* or *phlegmonous*. If the vessels become distended and dilated, the blood circulate slowly, the redness be of a purplish tinge, and the swelling considerable, with but little heat, the disease is said to be *congestive*. Of *unhealthy* inflammation there are numerous varieties: the *diffuse*, having a tendency to spread widely unchecked; the *strumous*, modified by scrofula; and the *specific* inflammations, that arise from special causes, and are frequently capable of self-propagation.

CAUSES OF INFLAMMATION.—The causes of inflammation may be divided, like those of all other diseases, into *predisposing* and *exciting*; and these again may either be of a strictly local character, or act locally through the medium of the constitution.

Local Predisposing Causes.—Though every tissue of the body is susceptible to inflammation, yet some parts are more liable to it than others. This cannot be owing to any greater degree of vascularity; for we find that the tissues lining the interior of a joint more readily and more violently inflame, though they are almost extravascular, than a portion of the mucous membrane, which is so abundantly supplied with vessels. Indeed, serous and synovial membranes are more liable than most other tissues to inflammatory excitement. Whatever the reason of this may be, there are two sets of causes that more especially predispose tissues to inflammation.

The local preventive treatment of inflammation is best carried out by the removal of all sources of irritation, by absolute rest of the part, and by the free application of cold. If the injury be superficial, and not very severe, lint dipped in cold water, frequently renewed, may be applied; or, if the skin be unbroken, an evaporating lotion may be used. Should a limb or joint be severely injured, cold irrigation will be a preferable mode of reducing its temperature. This may most conveniently be done by suspend-



Fig. 48.—Irrigating Apparatus.

(Fig. 48). In some cases the application of pounded ice in a bladder, or of cold evaporating lotions, may be preferred to the irrigation. Dry cold may be advantageously substituted for the moist in many cases. It has the advantage of not softening the skin, and is less likely to be followed by gangrene, which may result in consequence of the too incautious or long-continued use of cold and moisture. The dry cold is best applied by putting pounded ice into a thin vulcanised India-rubber bag, as recommended by Eschmarch.

At the same time, all constitutional irritation must be removed by abstinence, rest, and a free aperient.

In undertaking the *Curative Treatment* of inflammation, the surgeon must not allow himself to be guided by the name of the affection with which he has to do, but he must be influenced in the means that he adopts by the constitutional condition of the patient, by the type of the inflammatory fever, and by the state of the diseased part; for nothing presents greater variety than the management of the inflammatory process in different conditions of the patient, and in the different phases of that affection. We shall accordingly consider the treatment of inflammation as applied to the acute and sthenic, the asthenic and irritative, and the chronic varieties of the disease.

TREATMENT OF ACUTE INFLAMMATION WITH FEVER OF THE STHENIC TYPE.—In the treatment of this variety of the disease, active and energetic measures must early be had recourse to, especially if the patient be young and strong. There is no affection that is more under the control of the surgeon than this when occurring in a healthy constitution, and in which more can be done by active means early employed. It is consequently of the first importance that precious time be not lost by the employment of inefficient measures; otherwise important local changes and irremovable alterations of structure may ensue. It is also of great consequence to remove the disease fully; not only to subdue it, but to extirpate it, lest it degenerate into some of the more chronic, passive, and intractable forms.

The first thing to be attended to in the treatment of the sthenic, and of

ing over the part a large wide-mouthed bottle, full of water, in which a few pieces of ice may, if necessary, be put; one end of a skein of cotton, well wetted, is then allowed to hang in the water, whilst the other is brought over the side of the bottle. This, acting as a siphon, causes a continual dropping upon the part to which the cold is to be applied

canal, free the secretions, and equalise the circulation. It general, it will be found most advantageous to administer a mercurial, followed by a brisk saline purge; and this should be repeated from time to time during the progress of the case.

Diuretics and diaphoretics require to be administered frequently during the day. If the skin be hot and dry, antimonials should be given in small and repeated doses; these may advantageously be conjoined with, or replaced by, salines, such as the citrate of potass, the acetate of ammonia, or nitre. In this way the force of the heart's action is lessened, and the skin and kidneys are called into active operation. It is also probable that the salines alter the constitution of the blood, dissolving the fibrine and lessening the quantity of water, both of which constituents are in excess in inflammation.

In many forms of athenic inflammation, especially in those which affect the serous and fibrous membranes, we do not possess a more efficient agent than *mercury*, administered, not as a purgative, but as an alterative to the system. And I confess that I can in no way give my adherence to the doctrines of those who, disregarding the daily evidence of professional experience, deny the utility of the preparations of this mineral in the treatment of inflammatory disease. Mercurial remedies are of special service in aiding the operation of other medicines. Diuretics, diaphoretics, and purgatives, will frequently not act properly unless conjoined with a mercurial. In inflammation the preparations of mercury act as direct antiphlogistic agents, lessening the quantity of fibrine in the blood, and equalising the circulation. They are of especial value in promoting the absorption of exudation matters, more especially of lymph, as we may see happening under their influence in certain diseases of the eye. They appear to do this rather by lowering the vascular action of the part, and thus allowing the absorption to be carried on, which had been arrested during the persistence of the inflammation, than by any specific influence exercised over the effused fibrine. Care, however, is required in the administration of mercury. In irritable or cachectic constitutions it should not be given at all, or not without great caution. It is best borne by strong constitutions, and in acute inflammation of the serous and fibrous tissues.

Calomel, blue pill, and mercury and chalk, are the preparations usually employed when the mineral is given by the mouth. When it is administered endermically, the mercurial ointment is preferred; and the use of the mineral is in general continued until the gums become spongy, and a red line is formed at their edge; the patient experiencing a coppery taste in the mouth, and the breath becoming fetid. It is not necessary to induce profuse salivation.

It is especially the combination of calomel with opium that produces the most beneficial effects in the treatment of active surgical inflammation. Two grains of calomel, and half a grain or a grain of opium, every fourth or sixth hour, tranquillise the system and lessen vascular action in a remarkable manner, especially in acute inflammation affecting the jaws, the eye, or the serous membranes.

Opium is not only of use in the way that has just been indicated, but is of essential service in allaying the pain and irritability that often accompany inflammation, especially in many inflammatory affections of the bones and joints. In the form of Dover's powder, it is of especial value in this respect.

In the treatment of acute inflammation, it is of essential consequence that the patient should be kept at rest, in a well-regulated temperature, and on low

diet: in fact, the more complete the abstinence in this respect is, the more rapidly do therapeutic means act and the febrile symptoms cease.

Local Treatment of Acute Inflammation.—This is of the utmost importance, as it directly influences the tissues and vessels that are deranged in action. It consists of means of the most varied and opposite character:—heat and cold, iced water and hot fomentations; astringents and sedatives—are all employed, and all with success, but each only in certain stages and forms of the disease; and the art in conducting the local treatment of inflammation consists in adapting the various means at our disposal to the particular condition of the case before us.

Local blood-letting is the most efficient means we possess in directly lessening vascular action in a part, as by it we take the blood directly from the inflamed and turgid vessels. It may be used in addition to, though it is now very commonly employed in preference to, general blood-letting: especially if the inflammation be not severe, or if it occur at either of the extremes of life, in women, and in persons generally of feeble power.

Blood may be taken locally by *punctures, scarifications, or incisions*, or by *leeching or cupping*.

Punctures and incisions can only be practised in inflammation of the cutaneous and exposed mucous surfaces, due attention being had to subjacent parts of importance. They constitute a very efficient means of relief to the part, as not only is blood removed, but an exit is afforded for effused matters; tension is consequently materially lessened, and the tendency to sloughing and other evil after-consequences perhaps prevented. The removal of the tension of inflamed parts is not only of the greatest advantage locally, but is of considerable service to the system at large by lessening the pain and general irritation that are always occasioned by it. The punctures should be made with a fine lancet, in parallel rows over the inflamed surface, and should not exceed a quarter of an inch in depth. The incisions must always be made in the axis of the limb, and should be so arranged as to afford the greatest possible relief to the tension of the parts. Their extent superficially and in depth must vary according to the seat of the inflammation. Thus in the inflamed conjunctiva they must of course be very limited, whilst in phlegmonous inflammation of a limb they may be of much greater extent. Care, however, must always be taken not to wound superficial arteries or veins. A modification of puncture is sometimes practised by *opening the veins in the neighbourhood of the inflamed part at several points at once*. Thus, in inflammation of the testis the scrotal veins may advantageously be punctured. The bleeding from punctures and incisions should always be encouraged by warm fomentations.

Leeches are usefully applied to the neighbourhood of inflamed parts, but should not be put upon the inflamed surface itself, as their bites irritate. There are certain situations in which leeches should not be placed, as over a large subcutaneous vein, or in regions where there is much cellular tissue, as the scrotum or eyelids, lest troublesome hemorrhage or ecchymosis result. So, also, they should not be applied near a specific ulcer, lest their bites become inoculated by the discharge. The bleeding from a leech-bite should be encouraged by warm poulticing or fomentations for some time after the animal has dropped off. In this way from half an ounce to an ounce of blood may be taken by each leech. There is usually no difficulty in arresting the hemorrhage from the bite; should there be any, continued pressure with some scraped lint, felt, matico, or powdered alum, will accomplish this. If this do not succeed, which may happen in some situations where pressure cannot be conveniently applied, as on the neck and abdomen, particularly

in young children, a piece of nitrate of silver scraped to a point, or a heated wire introduced into the bite, previously wiped dry, or a twisted suture over and around it, may be required.

Cupping is the most efficient local means of removing blood that we possess, and the quantity extracted may be regulated to a nicety in this way. It cannot, however, be employed upon the inflamed surface itself, on account of the pain and irritation that would be occasioned, and is consequently chiefly applicable to internal inflammations. As the scars made by the scarificators continue through life, cupping should not be practised upon exposed surfaces.

In *cold* and *heat* we possess two most important local means of controlling inflammation. They cannot, however, be employed indiscriminately.

Cold.—There are two stages of inflammation in which cold may be employed with especial advantage: first, during the very early and acute stage, rather with a view of preventing or limiting the inflammation, so that it may not pass beyond the bounds of adhesive action; and next, when acute inflammation has passed off, the vessels of the part remaining relaxed and turgid: the application of cold acting as a powerful agent in restoring the tone of the parts.

Cold should never be had recourse to between these stages, when suppuration is coming on, or has set in; still less should it be employed when there is a tendency to mortification. Its long-continued and incautious use may indeed be followed by profuse suppuration or extensive sloughing of the inflamed part.

The modes of applying cold vary according to the part affected and the stage of the inflammation. In the early and acuter stage, and if the surface be inflamed, evaporating spirit lotions, to which sedatives may sometimes be advantageously added, are the best. If it be wished to influence the whole substance of a limb, irrigation with cold water should be adopted (Fig. 48). If it be intended that the effect of the cold penetrate deeply, as in inflammations of joints, of the head, spine, or chest, it may be applied by means of pounded ice. The ice is best applied by being placed in a bladder, gut, or a Mackintosh bag, partially filled. Dr. Esmaich has especially pointed out the great advantage of using ice in an India-rubber bag, which always remains dry, and from the use of which no danger from frost-bite is to be apprehended, as may occur from the long-continued use of cold and wet applications. With the view of removing the congestion consecutive on inflammation, cold douching or sponging is most efficacious.

Warmth and *moisture* conjoined are of the utmost service in the treatment of inflammation during the height of that process—during that period when cold applications are not admissible. By these means, tension is relaxed, effusion is favoured, and thus the over-distended vessels are relieved. If continued for too long a time, however, these means favour congestion, and sadden the parts. Warm applications are especially serviceable in all cases of inflammation attended by much pain, more particularly if this occur from tension; and they are especially useful when suppuration is threatening, or has come on, and in many cases where there is a tendency to slough.

When abscess threatens, or the surface is broken, nothing affords so much relief as a well-made poultice, either of linseed-meal or of bread; this, made soft and smooth, and not spread too thickly on the cloth containing it, should be applied as hot as the patient can bear it.

Water-dressing, consisting of doubled lint, well soaked in tepid water, and covered by oiled silk, or thin gutta-percha, extending from half an inch to

blood-letting acute inflammation of the conjunctiva, or that which is the consequence of a wound of the lung, in an otherwise healthy and robust man of thirty; whilst in a broken man of seventy, ammonia, bark, port wine, and brandy would be equally proper; but if we were (except under peculiar and exceptional circumstances) to reverse this treatment—to stimulate the young or vigorous, and to deplete the aged or feeble—we should act contrary to common sense, and probably destroy rather than cure our patients. It is of far greater importance to be able to estimate accurately the true constitutional condition of the patient, than to be able to form a minute diagnosis of the precise seat, extent, and depth of the local mischief. It is a fatal error, too often committed, to attach too much consequence to the recognition of the local malady, and too little importance to the character of the constitutional disturbance attending it. The surgeon who acts thus runs the risk of treating the Name and not the Thing. If we treat erysipelas or pneumonia as mere affections of the skin or lung, on one uniform plan, without reference to the type of the constitutional disturbance accompanying it, we shall miserably err in a considerable proportion of the cases. But if, paying but little attention to the local affection, except so far as its characters indicate the general type of the disease, we make the constitution of our patient our guide, and deplete or stimulate according to the state in which we find it, and thus perhaps treat two patients with the same disease, so far as name is concerned, on totally opposite plans, we shall not act inconsistently, but in strict conformity to the natural condition of the patient and of his disease.

We must, then, be entirely guided in the means that we adopt by the condition of the patient, the state of the tongue and pulse, and the general character of the symptoms. If these from the first partake of the asthenic or irritative type, we cannot at any period have recourse to the treatment that has been recommended in sthenic inflammation. If the disease commences in an active form, the fever progressively assuming a lower and lower character, merging into the asthenic and irritative types, so must we gradually alter the nature of our general treatment; and this is always a delicate procedure, requiring much caution. Though the inflammatory fever may at first assume the sthenic form, if there be reason to believe, from the broken constitution of the patient, or from the congestive or passive character of the local inflammation, that the constitutional symptoms will not long continue of this type, we must be extremely cautious how we lower the patient by active depletion; for, however high the fever may at first run (and in these cases there is often febrile disturbance of a very active character for the first few days), the disease speedily expends its force and rapidly subsides into a low form. In cases of this kind, which are of very common occurrence in London practice, more particularly in hospitals, we should never bleed, but content ourselves, after clearing out the bowels, with keeping the patient quiet on a moderately low diet, and administering diaphoretic salines. As the symptoms gradually merge into the typhoid type, the pulse with increasing frequency diminishing in power, the tongue becoming dry and dark, and the other symptoms of asthenia beginning to show themselves, we must begin to give some stimulant in combination with the salines. The carbonate of ammonia in five to ten grain doses, or even more, may be given with bark, or in an effervescent form with fifteen grains of the bicarbonate of potash and a sufficient quantity of citric acid, every third or fourth hour. The nourishment must be increased; and wine or alcoholic stimulants must be conjoined with it, in proportion as the symptoms of debility become more and more urgent. In effecting this change, we must be careful not to run into the error of overstimulating our patient; this

The patient might be bled to death, and still the increased vascular action would go on in the inflamed part, so long as there was a drop of blood circulating in his vessels. It is true that the same antiphlogistic means are employed in arresting the chronic as in cutting short the acute form of the disease, but in a less energetic manner; our object being to induce a gradual and continuous improvement in the state of the system and of the diseased part. Local nutrition is always modified in chronic inflammation; and it can only be restored to its normal condition by close attention to all the circumstances that tend to improve the patient's general health, as well as by producing an impression on the part itself by appropriate local means. Hence, in the treatment of chronic inflammation, hygienic measures are of the first consequence. In most cases, nothing can be done without proper attention to these; and much can be done by these that cannot be effected by any more direct medicinal means. The treatment of this form of inflammation must likewise be varied according as it is of an uncomplicated character, occurring in an otherwise healthy constitution, and assuming a sthenic type; or as it occurs in a cachectic and feeble system, assuming a congestive or passive character; or as it is met with in an unhealthy constitution, affecting a specific form.

In the management of these various forms of chronic inflammation the patient must be kept at rest, and, if the disease be at all extensive, confined to bed. He should be in pure air, and, as a general rule, be put on a light and unstimulating diet. The regulation of the diet is of much consequence, and the amount and quality of the nourishment afforded must be carefully proportioned to the age, strength, and previous habits of the patient, as well as to the degree and the seat of the inflammation, and the form of constitutional fever that accompanies it. In the more acute form of chronic inflammation, farinaceous slops, at most beef-tea, and light puddings, can be allowed. In the less active forms occurring in feeble constitutions, with depression of general power, animal food of a light kind may be given, and the scale of nourishment increased until stimulants, as beer, wine, or brandy, are allowed. Nothing requires greater nicety in practice than to proportion the diet, and to determine the cases in which stimulants are necessary. It may be stated generally that, the more the disease assumes the sthenic and passive forms, the more are stimulants required; until, at last, in the truly adynamic type, our principal trust is in these agents, and large quantities of wine, brandy, and ammonia are required to maintain life.

Mercury is of essential service in the more active forms of chronic inflammation; but in all cachectic and strumous constitutions it should, as much as possible, be avoided. It is not only of great use in arresting the further progress of the disease, but especially in causing the absorption of some of the effusions that result from it, and in removing some of the other effects of chronic inflammation, such as thickening, hardening, and opacity of the parts. It should be given in small doses for a considerable length of time, until the gums are slightly affected. In many cases of depressed power it may be very advantageously conjoined with bark or sarsaparilla. The most useful preparations are calomel in half-grain or grain doses, and the iodide of mercury in the same quantities; or, if a gradual and continuous effect be required, the bichloride in doses from one-sixteenth to one-eighth of a grain.

Iodide of potassium is an alterative and absorbent of the greatest value, especially in chronic inflammations of fibrous or osseous tissues occurring in strumous constitutions. In these it may often be substituted with great advantage for mercury, and given in those cases in which that mineral would otherwise be administered. In many cases, it is of essential service after a

By means of *blisters* applied either directly over the inflamed part, or at a little distance from it, the surface being kept raw and exuding by some stimulating application, effusions and those chronic structural changes that accompany the more advanced stages of inflammation may be removed.

In the latter stages of chronic inflammation, the *pyogenic counterirritants*—*issues*, *setons*, and the *cautery*—may be very advantageously employed. By these a powerful derivative action is induced, and chronic thickening may be melted away.

Issues are of especial service in chronic inflammation of the viscera, joints, and bones, before suppuration has taken place; they should be applied in the soft parts over the affected structures, and may be kept open for a very considerable length of time. They are best made in the following manner. A piece of common adhesive plaster, about two inches square, having a hole of the size of a shilling cut in its middle, is fixed upon the part where the issue is to be made; a piece of potassa fusa, of about the size of half a cherry-stone, is then placed on the surface left uncovered by the circular central aperture, a square piece of plaster being laid over all. The patient experiences a burning pain for about two hours, when it ceases; on removing the plasters, a black slough corresponding in size to the central aperture will be found. This must be poulticed for a few days until it separates, and the raw surface then dressed with savins ointment, or stimulated by an issue-bend. Whenever it shows a tendency to heal, it may be kept open by an occasional application of the potassa fusa.

A *seton*, when counter-irritation is to be applied over very deep-seated parts, is more useful than an issue. The seton may most conveniently be



Fig. 49.—Introduction of a Seton.

made in the following way (Fig. 49). A fold of skin about two inches or more in breadth is pinched up, and its base transixed by a narrow-bladed bistoury. The blunt end of an eyed probe, threaded with the seton, is next pushed along the back of the blade from heel to point, which being withdrawn as the probe is carried onwards, the seton is left in the wound. A poultice should then be applied.

The *actual cautery* is especially successful in deep-seated chronic inflammation, as of joints, when a deep and prolonged action is required to be set up. The cauterising irons may be of various shapes. They should be heated to a dull-red heat, and then quickly drawn in lines, crossing one another over the part.

Astringents directly applied to the inflamed parts are of extreme service in those forms of congestive or passive inflammation in which the circulation is sluggish and the capillaries loaded: they afford relief in these cases by inducing contraction of the vessels. In order to ensure their proper action, they must be employed of sufficient strength; for if too weak they irritate, and increase rather than relieve the congested condition. The nitrate of

great measure mechanical, depending on the dynamic state of the vessels, though doubtless in many instances modified by other causes of a vital character. Fibrine, or lymph, though usually spoken of as an inflammatory effusion, differs so remarkably in its vital characters from the rest, and is so evidently a new formation, that I shall consider it separately.

The frequency with which one or other form of effusion occurs in different tissues, or organs, varies greatly. Paget observes, "each tissue has its proper mode and products of inflammation," hence particular kinds of effusion are very rare in some, although of common occurrence in other parts.

1. *Effusion of Blood* often occurs in small quantity, tinging the other products of inflammation. When this is the case, the colouring matter is broken down and dissolved, a condition indicative of a low state of the constitutional powers. In other cases, the hemorrhage may be abundant, the character of the blood being but little changed. This effusion is dependent upon overdistension of the vessels, with softening of the tissues, giving rise to rupture of the capillaries, without which it cannot occur, there being no such thing as *transudation* of blood in inflammation. Hemorrhage of this kind most frequently occurs from mucous surfaces, which readily bleed when inflamed. It may also happen from the rupture of new vessels in freshly deposited lymph.

2. *Effusion of Liquor Sanguinis*.—In this case, the fluid parts of the blood transude, leaving the red corpuscles behind. It is occasionally met with in so-called serous effusions, into the tunica vaginalis for instance; so also the serum contained in the bleb of a blister is really liquor sanguinis; and Paget has found that in this there is most fibrine when there is most strength of constitution. This fluid is not uncommonly met with in the subcutaneous and submucous cellular tissues; about the glottis, and in the scrotum, for instance, giving rise to a gelatinous semi-transparent swelling of the part. In these cases, the more fluid portions are sometimes absorbed, leaving the fibrine, thus constituting the condition termed *solid eczema*. The fibrine in this effusion often does not coagulate so long as it is retained in the body; but when it is removed, solidification ensues.

3. *Serous or Albuminous Effusions* are very common in slight or subacute inflammations of serous and cellular tissues, giving rise to dropsies and *oedema*. They most frequently contain a small admixture of fibrine, approaching somewhat to the characters of the last-mentioned effusion. The quantity of the fibrine contained in them is usually a measure of the degree of the inflammation. These serous accumulations form and are absorbed with great rapidity, and their absorption is usually most rapid when the fibrination is least.

4. *Secretions of Tissues and Organs* undergo changes in quantity and quality, under the influence of inflammation. The quantity is at first increased; but during the active stage of the inflammation, when there is much tension, it becomes diminished, the part being almost dry; as the inflammatory action subsides, and relaxation of the vessels ensues, it again becomes increased.

The alteration in quality in secretions from glands is chiefly due to the admixture of morbid secretions from the mucous membrane. When a serous membrane is inflamed, the secretion not only accumulates in greatly increased quantity, as in acute hydrocele, but it becomes turbid by the admixture of flakes of lymph, which are sometimes so abundant as to give it a puriform appearance. In other cases true pus is formed, as in inflammation of the anterior chamber of the eye, terminating in hypopyum. In inflammations of the cellular tissue the quantity of fluid is either simply increased, or it

and shape than these, and usually exhibit from two to three nuclei when treated with acetic acid. They form in about four-and-twenty hours after inflammation has been set up, and may either develop, passing upwards through fibro-cells, caudate-cells, &c., into filaments; or may degenerate into pus corpuscles, granule-cells, granular matter, and *débris*.

These two primary forms of lymph, the fibrinous and the corpuscular, are almost always found together, but existing in various proportions in the same exudation-mass; the relative quantity of the one or the other element determining whether it shall undergo development or degeneration. Paget observes that "the larger the proportion of fibrine in any specimen of inflammatory lymph (provided it be healthy fibrine), the greater is the likelihood of its being organised into tissue;" this preponderance of fibrine being indicative of adhesive inflammation. And "the larger the proportion of corpuscles, the greater the probability of suppuration or some other degenerative process;" the preponderance of corpuscles being a general feature of suppurative inflammation.

Why does lymph at different times assume different forms, fibrine preponderating in some, corpuscles in other cases? Or, in other words, why do we find a tendency to adhesive inflammation in some, to suppurative inflammation in others? This question, which has been closely investigated by Hunter, Bichat, Rokitsansky, and C. J. B. Williams, has been very clearly replied to by Paget as referable to three causes:—1. The state of the blood; 2. The seat of the inflammation; 3. The degree and character of the inflammation.

1. *State of the Blood*.—Paget applied blisters to thirty different patients, and collected the sero-fibrinous fluid that accumulated in the blebs. In those who were suffering from purely local diseases, the constitution being otherwise healthy, the fibrine was firm, filamentous, and elastic; in cachectic or phthisical patients it was almost wholly corpuscular, with every intermediate variety, according to the condition of the system. As a general rule, in young persons and in those of sound constitution, the fibrine is plastic; hence it is in these individuals that we may chiefly look for the union of wounds by adhesive inflammation.

2. *The seat of inflammation* modifies its product very considerably, as Bichat and Hunter long ago pointed out. Serous membranes are prone to fibrinous, the mucous to suppurative inflammation; and in cellular tissue, both fibrine and corpuscles are found. This general rule, however, is subservient to the state of the constitution, and to the influence of certain specific diseases. Thus in diphtherite and croup, lymph is poured out on the mucous membrane of the throat; whilst in empyema, pus is formed in the cavity of the pleura.

3. *The degree and character of the inflammation* modify considerably the product. In slight inflammations it is almost always corpuscular; in the more acute and active, of a fibrinous character. Certain forms of inflammation are always attended by specific products. In pyemia, for instance, all the products have a suppurative tendency, even when serous membranes are inflamed. In croup, on the other hand, there is a disposition to plastic effusion even on mucous surfaces.

AFTER-CHANGES.—Lymph that has been poured out is susceptible of three important changes: viz., *Absorption*, *Development*, and *Degeneration*.

When lymph undergoes *Absorption*, it probably breaks up and dissolves in the fluids of the part, being carried off by the vessels; these changes we not unfrequently see taking place in an inflamed eye.

Development of Lymph.—In a healthy constitution and with a healthy local condition, lymph evinces an upward tendency in the scale of development,

The steps by which this interesting process is accomplished, are the following. At first, small lateral dilatations or pouches appear at some points on the walls of the nearest old vessels; these grow out into the plastic mass, bend towards each other, coalesce, and form a loop or fork. These loops give rise to secondary vascular outgrowths; and thus the vascularisation of the lymph is completed.

Travers states that these vessels are visible, like fine striae, before the circulation can be detected in them. A single globule of blood first enters; this is followed by others, which for some time have a see-saw or oscillatory motion, progressing gradually towards the nearest vessel, by the entrance of the blood into which the circulation is completed, and becomes continuous and equable.

Degeneration of Lymph.—This has been especially studied by Paget. He observes that it may wither and harden, forming dry, horny masses or vegetations; that it may undergo fatty degeneration, and become converted into granular matter. These last two forms of degeneration are frequently met with in the coats of diseased arteries. Besides these changes, it may calcify, being converted into an inorganic earthy material; it may undergo pigmentary changes; and, lastly, it is very frequently converted into pus.

SUPPURATIVE INFLAMMATION

The *suppurative* is that form of inflammation which gives rise to the production of pus; and pus never occurs except as the result of this form of inflammatory action.

CHARACTERS OF PUS.—Pus presents considerable variety in its general character, according to the nature of the constitution of the patient, or the condition of the part in which it is formed.

When formed in a person of healthy constitution, as the result of sthenic inflammation, it is an opaque, creamy fluid, thick, smooth, and slightly glutinous to the touch; of a yellowish-white colour, with a greenish tinge, having a faint odour and an alkaline reaction. Chemically, it is composed of water containing albumen, fibrine, saline, and fatty matters in solution and admixture, and usually gives off a small quantity of ammonia. Pus presenting these characters is termed *healthy* or *laudable*.

When admixed and tinged with blood, it is said to be *sanious*; when thin, watery, and acrid, *ichorous*; when containing cheesy-looking flakes, it is termed *curdy*; and when diluted with mucus or serum, it is frequently called *mucopus*, or *seropus*. Besides these, pus presents many other varieties. Thus, for instance, when formed from bone, or in the neighbourhood of the alimentary canal, it has a peculiar fetid odour. Its chemical composition may likewise vary under different circumstances: thus, ordinary pus formed in the soft parts contains merely a trace of phosphate of lime, whereas that which is formed in connection with diseased bone has been found by B. Cooper to contain $2\frac{1}{2}$ per cent. of this salt. Sometimes animalcules are found in pus; vibriones are met with in some kinds of pus from the genital organs. Pus presents other peculiarities, which are only cognisable by their effects on the system: thus, the pus from specific sores possesses contagious properties, though in chemical, microscopical, and physical constitution, it does not differ from other forms of that fluid.

Microscopic Characters.—On examining pus under the microscope, it is found to consist of corpuscles floating in a homogeneous fluid, the "*liquor puris*." These corpuscles appear to be modifications of the exudation cell; being composed of a semi-transparent cell-wall, containing two or three nuclei, which are rendered very apparent by acetic acid (Fig. 50). Besides

exudation-cells become transformed into pus-corpuscles. A drop of pus is thus formed in the inside of the exudation matter already effused, or at the moment of its evolution, as the result of changes imprinted on it by contact with the inflamed parts. Around the pus thus formed, the lymph deposited in the substance of the tissues, and filling up their interstices, forms a consolidated mass, which plays an important part in limiting the further extension of the suppuration. As the suppurative action advances, the corpuscles composing the innermost layers of this plastic mass are gradually transformed into pus-cells; the blastema losing its plasticity, and degenerating into liquor puri.

The purulent accumulation thus formed, constituting an abscess, is always retained, in healthy states of the system, by a boundary of consolidated lymph, which extends itself by fresh deposits on its outside, and by the liquefaction and metamorphosis of its interior, as the central formation of pus increases. This boundary of lymph has been termed the *pyogenic membrane*, and was supposed by Delpsch to be the secreting organ of pus. This, however, it is not; and that it is not necessary for the secretion of pus, is shown by the facts, that it is not found in the early stages of suppuration, that on free surfaces suppuration occurs without it; and that it is absent in certain kinds of abscesses—the diffused and the metastatic. A better term for it would be the “limiting fibrine,” as it limits or bounds the spread of suppurative action. Its absence is usually indicative of a want of power in the system; the suppuration then becoming diffused, extending itself indefinitely through the cellular tissue.

DIAGNOSIS.—The diagnosis of pus is usually easy, but some fluids resemble pus so closely to the naked eye, that the microscope is necessary to establish their characters. From *healthy mucus* there is no difficulty in distinguishing pus; but when mucus has been thickened and rendered opaque by inflammation, and is mixed with exudation-cells, it is impossible, and can never be necessary, to distinguish it from pus. *Turbid serum*, containing broken-down and granular fibrine, frequently met with in serous sacs, closely resembles pus; here the diagnosis may be effected by the absence of cells. *Softened fibrine*, as in clots and inflamed vessels, often closely resembles pus to the naked eye, but the microscope reveals the true nature of the fluid by the absence of exudation cells. *Atheroma* may be distinguished from pus by the presence of cholesterine granules and fat, and by the non-existence of the characteristic pus-corpuscle. In *tubercle* and *cancer* the absence of the true pus-cell, and the presence of appearances characteristic of these morbid products, establish the diagnosis. When it is admixed with *blood*, the detection of pus is often very difficult, and, indeed, cannot in many cases be satisfactorily accomplished; the white corpuscles have sometimes been mistaken for its cells, to which they have a great resemblance. When pus is diffused in *milk*, as in some forms of lacteal abscess, the corpuscles of this fluid will be seen to be smaller and clearer, with a more defined outline than those of pus.

The **DURATION** of suppuration varies greatly. Inflammation very commonly terminates in the formation of pus, in the course of about three days; at other times a much longer period than this is required, the inflammatory action being of a passive and languid character. When once suppuration has been set up, it may continue for an indefinite time; pus becoming, as it were, the established secretion of the part. It is not uncommon to find purulent discharges from mucous membranes continuing for years.

The **Characters** of suppurative inflammation vary according as it is healthy, unhealthy, or specific.

1. The *State of the Patient's Health* exercises a great influence on the probable tendency to suppuration. The sounder the constitution, the less is the chance of inflammation running into the suppurative form. And indeed we may often, in surgical practice, look upon the suppurative tendency of wounds as a measure of the state of the patient's health. Thus, in scrofulous constitutions, the inflammation that is excited by a trivial injury, as the sprain of a joint for instance, is very apt to run on to suppuration. So again, in certain cachectic states of the system, slight wounds suppurate, or fester, as it is termed.

2. The *Specific Character of the Inflammation* often determines the super-vention of suppuration: some diseases, such as gonorrhœa and purulent ophthalmia, consisting essentially in the secretion of pus by a free surface.

3. The *Seat of Inflammation* also exercises considerable influence. Thus, mucous membranes, when inflamed, almost invariably suppurate, the transition from their normal secretion to pus being very readily effected. Serous membranes do so but rarely: the puriform fluid secreted by them when inflamed being in most cases nothing but turbid serum.

4. The *Intensity of the Inflammation* increases the liability to the formation of pus; hence pus usually forms in the centre of inflamed parts. When the inflammation is of an active sthenic character in a healthy constitution, it requires considerable intensity to give rise to suppuration. It is only where the system is strongly predisposed by struma or cachexy, that very slight inflammations terminate in this way. The degree of inflammation required for the formation of pus varies greatly, but it is always greater than that necessary for plastic exudation.

5. The *Local Condition of the Part* influences the probability of suppuration. Thus a subcutaneous wound, as in tenotomy, does not suppurate; but if it be opened, and its interior exposed to the air, then degeneration of exudation-cells, which constitutes their conversion into pus, takes place. For the same reason all ulcers suppurate. The lodgment of foreign bodies, as of urine, a piece of bone, or a bullet, by exciting intense and continuous inflammation, almost inevitably leads to suppuration, which is indeed the means adopted by nature for their removal from the system.

TREATMENT—The treatment of this form of inflammation is divisible into local and constitutional.

Local Treatment.—This presents three indications:—

First, to remove the cause; as by extracting a piece of dead bone from the bottom of a sore.

Secondly, to lessen inflammatory action by appropriate means; thus either removing the inflammation entirely, or confining it within those limits that are compatible with the effusion of plastic matter.

Thirdly, to facilitate the escape of the pus, if it be lodged in tissues or deep cavities; and to moderate or arrest the amount of its discharge, when it is poured out from a free surface, by the use of astringents of various kinds, or by the proper employment of pressure.

Constitutional Treatment.—With the view of preventing the occurrence of suppuration, we must be careful to maintain the powers of the system, and not to reduce the patient too much, even if the inflammation be of a sthenic character at the outset. Suppuration is a condition of debility, and is especially predisposed to by any previously existing enfeebled state of the system, or by malnutrition. Another reason for the avoidance of the early employment of debilitating means is, that, if suppuration once be established, the drain on the system may eventually be so considerable as to require all the patient's powers to enable him to bear up against it. Hence they should

matory process, soften and break down, becoming converted into ill-organised pus, mixed with the *débris* of the part.

Tissues that have been congested for a long time are apt to inflame under the influence of some trivial exciting cause, and rapidly to run into ulceration. This usually commences in the centre of the part, where the nutrient action is lowest; here a small sore forms, which exudes thin unhealthy pus, and rapidly extends. So long as the sore is inflamed, it continues to spread, and reparation cannot go on in it. It would appear as if a moderate degree of inflammation were too intense for the vitality of chronically congested tissues, or of those in which lowly organised fibrine has been effused. The more the vitality of a tissue is reduced, the less appears to be the degree of inflammation that is required to produce disintegration and ulceration of it. Indeed, if the vitality of a part be sufficiently lowered, it may fall into a state of ulceration without the occurrence of inflammation, or with so slight a degree as scarcely to be appreciable: the ulcerative action appearing to arise from disintegration dependent upon the want of nutrition. Thus, for instance, in scrofula and in other diseases, as scurvy or syphilis, where there is an imperfect nutritive force, a tendency to softening and breaking down of structure, and consequent ulceration, occurs; and this tendency is much increased by the occurrence of congestive or subacute inflammation in the part.

Ulceration is so intimately allied with sloughing and gangrene, that it is very difficult to separate its causes from those of these other conditions.

CAUSES.—The *Predisposing Causes* of ulceration are chiefly found in those conditions that interfere in any way with the nutrition of a part. A feeble circulation, such as often exists in the lower limbs, in the *alæ* of the nose, and in newly formed or recently cicatrised parts, tends to the formation of ulcers. As age advances, nutrition becoming impaired and the circulation less active, slight causes suffice to disintegrate the structure of a part; and malnutrition, or loss of innervation from any cause, by lessening the vitality and resisting power of tissues, has a tendency to give rise to ulceration. Hence we so commonly see ulcers of the legs in elderly people, more particularly amongst the poorer classes, arise from slight irritation or pressure. In the dogs that Magendie starved by feeding them on sugar, gum, or oil and distilled water, ulceration of the cornea occurred. This must have been the result of ample malnutrition, rather than of inflammation.

Ulceration may be directly *excited* by the intensity of the inflammation at once destroying or disintegrating a part; by a severe mechanical injury, long-continued pressure, or the application of a chemical irritant, producing direct breach of surface, and, lastly, by the influence of certain specific diseases, which are accompanied by want of nutrition, as scurvy and some scrofulous affections, the peculiar character of which consists in the ready production of ulcerative action.

FORMS OF COMMENCEMENT.—Ulceration may commence in several distinct ways on the cutaneous and mucous surfaces.

1. There may be such a degree of acute local inflammation as rapidly gives rise to "molecular death" of the part. If the action be not a very acute one, and the destruction of the tissues not very rapid or extensive, the disorganised matters become mixed with pus, and are discharged in the form of a dirty, brownish, puriform fluid. If the action be more violent than this, complete disintegration does not take place in the affected part, but shreds of the spoilt tissues continue attached for some time to the ulcerated surface, giving it a very ragged appearance. If the inflammation be of a more intense character, layers of disorganised tissue, constituting

the surface, losing their sharp-cut appearance; and the discharge assumes the characters of healthy pus.

We now proceed to study the changes that occur in an ulcer during the stage of repair, the processes of *Granulation* and of *Cicatrisation*.

Granulation.—So soon as inflammation and extension of ulceration are checked, the surface of the ulcer, as has already been stated, becomes covered by a layer of plastic matter. This plastic layer, separating the ulcer from surrounding and adjacent tissues, forms a basis to it, from which the granulations, the organs of repair, spring up. Before this plastic basis can be deposited, it is necessary that the inflammation be reduced within those limits that are compatible with plastic effusion. So long as inflammatory action exceeds this limit around the edge or at the base of the ulcer, no lymph is effused. But as soon as this undue action is checked, lymph is thrown out, which becomes vascular by vessels shooting into it from below; and assumes a granular form from its deposition in papillæ, or granulations, which are consequently composed of exudative matter that has become vascularised in the way that has already been described. In the great majority of cases, granulations are only formed on surfaces exposed to the air and secreting pus; but they may be formed without exposure to the air or the formation of pus, as Hunter and Paget have shown to occur in some cases of fracture, the ends of the bones being covered by a distinct layer of florid granulations. That these granulations are in reality composed of lymph that has become vascular, is evident from the interesting fact observed by Hunter, and which every surgeon must have had repeated occasion to verify, both in wounds and compound fractures—that a portion of bluish-white semitransparent lymph effused on the surface of the sore or denuded bone is seen to become vascularised, and to be converted into true granulations, in from twenty-four to forty-eight hours.

The microscope shows that granulations are composed of cells heaped up without much, if any, apparent order, and connected by but little intermediate substance. When single, they are colourless; when in clusters, they become ruddy. It is interesting to observe how these cells undergo different changes in different parts of the same ulcer. Those situated at the base nearest the attached surface of the granulation, constituting its deeper layers, undergo development into filaments and fibro-cellular tissue; those on the surface are either thrown off in a rudimentary form, or degenerate into pus-cells; whilst those at the edges become converted into epithelial scales. Thus we see the same action giving rise to exudation-corpuscles, to pus, to epithelium, and to fibro-cellular tissue.

The *development of vessels* in granulations—a most wonderful and beautiful process by which thousands of vessels may form in a day on a healthy granulating surface—is identical with their general development in lymph, which has already been described: a series of loops and arches being formed as outgrowths from neighbouring vessels.

The *sensibility* of granulations varies considerably, being often greatest in those which spring from tissues that are naturally the least sensitive, as bone, for instance. No nerves have been traced in granulations; hence their apparent sensibility would appear to depend upon that of the subjacent inflamed tissues.

The *characters* of granulations afford important indications to the surgeon as to the condition of the surface from which they spring, and the state of the patient's general health. Granulations indicative of a healthy local and constitutional condition are small, florid, pointed, close set, and bathed with healthy pus; the use of which appears to be to cover and protect the tender

We have seen that granulations tend to contract during the healing of an ulcer, and that the diminution in surface thus produced facilitates greatly its cicatrization. Hence a scar is never so large as the original sore. This contraction continues, however, and does not attain its maximum until long after the completion of cicatrization, often occasioning great puckering or deformity. The degree of contraction depends partly on the seat of the scar, but principally on the agent that produces the ulcer; if the scar be seated on a part where the skin is very tense, the contraction will be slight; if the skin be naturally loose, it will be considerable. The contraction that takes place in scars which result from burns is greater than in those which occur from any other cause, often producing serious deformity and great distress to the patient. These results do not supervene in their fullest extent until after a lapse of some weeks or months from the infliction of the injury. This contraction would appear in some cases to be due, not only to the consolidation of the texture of the scar, but to the development in it of yellow elastic tissue.

Two great changes are wrought by time in the texture of a cicatrix: its tissue assimilating more and more to the normal structure of the part, and its deep attachments becoming more movable. When first a scar is formed, it is thin, reddish, or bluish and shining, being composed of imperfectly developed filamentous tissues, covered by a thin epithelial layer. As it becomes older, it assumes a dead-white colour, and becomes depressed, and gradually, but slowly, many years being required for the change, it "wears out"; that is to say, its structure more closely resembles that of the texture of the part on which it is seated. It never, however, becomes developed into true skin, as neither hair nor sebaceous or sudoriferous glands form in it.

In structure, cicatrices are composed of a fibro-cellular tissue, rather sparingly supplied with blood-vessels, and covered by a thin epithelial covering, usually smooth and glistening, but sometimes nodulated and rugose.

The sensibility of the cicatrix itself is lower than that of the skin generally, but it will usually be found that the edges of the integument, when in contact with the cicatrix, are more highly sensitive than are the integuments on other parts of the body. When tough and irregular cicatricial bands, or "*bridles*," stretch across a part, it will usually be found that they are devoid of sensibility.

Coincidentally with these changes, the scar loosens its deep attachments, so that it can be moved more freely upon subjacent parts. It is a long time before the scar attains the vitality of the older structures, if ever it do so completely; and the larger it is, the less its power will usually be. Under the influence of scurvy or syphilis, an old scar is apt to open up again; so also, if a fresh ulcer is formed on the old cicatrix, it will take a longer time to heal than the original one.

DIAGNOSIS OF ULCERS.—This is readily made when they are seated on the skin, where no art is required to recognise a sore. On the mucous surfaces, however, it is not always easy to do so; enlarged follicles and crypts, or aphthae, being constantly confounded with ulcers. The difficulty here proceeds from the circumstance that muco-pus may be poured out from a simply inflamed surface, or from one in which the abraded epithelium and open crypts are mistaken for ulcers.

TREATMENT.—In the *Local Treatment* of ulcers, the following points should be particularly attended to. 1. Inflammation must be subdued; until this be done, no proper reparative action can go on. This is accomplished by the ordinary local antiphlogistic treatment. 2. Position and rest are essential, in order that congestion or determination of blood may not take place. 3. Proper

The *Constitutional Symptoms*, always of a low type, vary according to circumstances. If the blood be healthy, and the constitution sound, the gangrene occurring as the consequence of severe injury, the symptoms will present the ordinary character of inflammatory fever, though even in these cases there is a great tendency to asthenia. If the constitution be broken, or the blood in a diseased state, the constitutional symptoms will rapidly run into the irritative form.

ARREST OF GANGRENE.—The progress of gangrenous inflammation would be indefinite, were it not arrested by the adhesive process which limits it, just as it bounds the suppurative inflammation. So soon as the gangrene reaches a part the vitality of which is too active to be destroyed by the inflammatory action, and where inflammation consequently takes on that form which it always does in healthy tissues—the adhesive; or, if the inflammation, gradually lessening in severity as it extends from its gangrenous centre, subsides to that degree which is compatible with the formation of lymph, the *line of demarcation*, as it is termed, is formed. This line is a kind of barrier, or septum of plastic matter, poured out into the interstices of the healthy tissues at their extreme limits next the gangrene; the line, indeed, along which the dead and living parts touch. It extends along the whole depth of the gangrene, completely surrounding it on all its attached sides. The inflammation does not cease abruptly in this line, but fades away in the healthy parts beyond it.

So soon as the gangrene is arrested, nature endeavours to throw off the spoilt part. This is effected by a process of ulceration, extending through the line of demarcation, and loosening the slough by the absorption of that layer of living tissue which lies next to it. This line of ulceration is termed the *line of separation*, and extends itself along the extreme margin of the living tissues; the dead parts being removed solely by actions going on in the contiguous living structures, except where they may be partially disintegrated by the pus that is thrown out.

This process of separation commences at the edge of the slough, which gradually loosens, and slowly extends downwards to the whole depth of the gangrene; if this affect the entire thickness of a limb, the ulceration will find its way completely across it. If the slough be more superficial, the ulcerative action passes underneath it, detaching it gradually. The line of separation is usually oblique, the soft parts being first divided, and the hard tissues then ulcerated through, until the ligamentous or osseous structures are reached, which are slowly acted upon by it. This action is most rapid in the soft parts and in young subjects.

After the separation of the gangrenous part, a more or less ragged, irregular ulcerated surface is left, which, if not too extensive, will undergo ordinary cicatrization. As ulceration extends across the limb, the largest arteries and veins are cut through by it, without hemorrhage resulting, owing to a mass of plastic matter being poured out in their interior, and blocking them up from the line of separation to the nearest large collateral branch above it. The period required for the detachment of gangrenous parts varies according to their extent. Small sloughs may be detached in a few days, whilst many weeks are required for the separation of a limb.

TREATMENT.—Depressing remedies must be very sparingly used, the patient's condition being usually not of such a nature as to bear lowering. It is very easy to knock down the inflammation by energetic measures; but, at the same time, the reparative power of the system is destroyed, and the patient may not be able to rally. Inflammatory fever, however high it may be in the early stages, rapidly sinks after gangrene has set in, symptoms of

charcoal powder. No poultices should be applied if the sloughs be large, heat and moisture hastening their decomposition ; but if they be small, yeast, carrot, or charcoal poultices may be advantageously applied.

Parts that are quite dead, but that do not readily separate, such as tendons, ligaments, and bones, may be cut through with scissors, pliers, or saws, and thus many weeks or months saved in their separation. It may occasionally be necessary in doing this to encroach on the living tissues ; this should be done as carefully as possible, for reasons already stated. They do not bleed much, owing to their infiltration with lymph.

The line of separation should be dressed with water-dressing, or with some mild detergent lotion or ointment, in order to keep the surface clean and free from absorption of gangrenous matters. If sloughs be not readily separated, the balsam of Peru, either pure or diluted with yolk of egg or very dilute nitric acid, and opiate lotions, are the most useful applications. After the separation of the sloughs, the ulcerated surface must be treated on general principles.

The *Constitutional Treatment* of gangrenous inflammation requires to be conducted upon the principles that guide us in the management of the asthenic and irritative forms of inflammatory fever. It should consist of attention to hygienic measures, and the moderate employment of depressing remedies, in the early stages ; support of the system, by means of light tonics, nourishment, and stimulants, as the disease assumes an asthenic form ; and the administration of opiates, as it sinks into the irritative type.

the injury influences materially its effects on the nervous system. If the patient be anxiously watching for the infliction of a wound, as waiting for the first incision in a surgical operation, all the attention is concentrated upon the coming pain; it is severely felt, and the consequent shock to the system is usually great. If, on the other hand, the attention be diverted,—if, as in the hour of action, the feelings be roused to the highest pitch,—a severe injury may be inflicted, and the patient may be entirely unconscious of it, feeling no pain, and experiencing no shock, not knowing perhaps that he is wounded till he sees his own blood. The severity of shock is in a great measure proportioned to the degree of pain attendant upon an injury. And, as sensibility to pain varies greatly in different individuals, so will the attendant shock.

The sudden occurrence of a severe injury will, however, induce a *physical impression* independently of any mental emotion or moral influence. Thus, if a limb of one of the lower animals be suddenly crushed by the blow of a hammer, the force and frequency of the heart's action immediately becomes considerably lessened. Here there can be no mental impression. So in man, it is found that the severity and the continuance of the shock are usually proportionate to the severity of the injury, either from its extent or from the importance of the part wounded. Thus, if the whole of a limb be torn away by a cannon-shot, or crushed by a railway-train, the shock will be severe from the extent of the mutilation, though the part injured be not immediately necessary to life; whilst, on the other hand, if a man be shot by a pistol-bullet through the abdomen, though the extent of the injury be trifling, and merely a few drops of blood escape, yet the shock to the system will be severe, owing to the importance of the part injured in the economy. The surgeon not unfrequently employs this fact as an necessary means of diagnosis. Thus, if a man break his leg, and at the same time strike his abdomen, and the shock be very serious and long-continued, without sign of rallying, the probability is that some severe injury has been inflicted upon an internal organ: injury of the viscera occasioning greater severity and longer continuance of shock than a wound of a less vital part.

The *Remote Constitutional Effects* of injuries are of a very varied character. In some cases, persons who have met with serious injury will be found to die suddenly, some months after apparent recovery. In others, they gradually fall out of health, the nutrition of the body appearing to become impaired, and a cachectic state supervening. In other instances, again, the functions of the nervous system become disturbed; paralytic symptoms of a slight but persistent character eventually developing themselves.

These remote constitutional effects, to which attention has been directed by Hodgkin and James, often do not manifest themselves for weeks or months after the infliction of the injury. Some change appears to be induced in the condition of the blood, or in the action of the nervous system, that is incompatible with health. Perhaps, as Hodgkin supposes, the part locally injured becomes incapable of proper nutritive action, and thus a morbid poison results, in consequence of some peculiar combination of the chemical elements of the part, by which the whole system is influenced. Be this as it may, the fact remains certain, that constitutional disturbance, serious illness, or even sudden death, may supervene, as a consequence of a local injury, a considerable time after its infliction.

Treatment of Shock.—If the disturbance be chiefly of a mental character, the patient will usually rally speedily on being spoken to in a kind and cheering manner, or on having a little wine and water, or ammonia, administered. If the shock be of a more severe character, and be the result of

from the arm, with leeches and ice to the head, purging and low diet, will subdue it ; but in many cases it is speedily fatal.

The *Irritative or Nervous Delirium* usually occurs in persons of a broken constitution, and closely resembles ordinary delirium tremens ; sometimes it is preceded by a fit of an epileptic character. In this form of the disease the pulse is quick, small, and irritable ; the pupils dilated ; the surface cool ; the countenance pale, with an anxious, haggard expression, and bedewed with a clammy sweat. The tongue is white, and there is sometimes tremor of it and of the hands ; but this by no means invariably occurs. The delirium is usually of a muttering and suspecting character ; the patient is often harassed by spectral illusions, but will answer rationally when spoken to. This form of disease is sometimes very rapidly fatal. I have known it to destroy life in cases of simple fracture in less than twelve hours.

The *Treatment* of irritative traumatic delirium consists essentially in the administration of opium until sleep is procured, or the pupil becomes contracted. For this purpose large quantities are frequently required, and the drug should be given in full doses, and repeated every second or third hour.

If there be much depression, it will usually be expedient to administer the opiate in porter, or in that stimulant to which the patient—if a drunkard—has habituated himself. The administration of the opiate should be preceded by a free purge and an aperient enema, so that all source of irritation may be removed from the intestinal canal. A strait-waistcoat is commonly necessary in all cases of traumatic delirium, in order to prevent the patient from injuring the wounded part.

After sleep has been induced, the quantity of the opiate must be lessened ; but it will be found necessary to continue it for some time, as there will be a tendency to the recurrence of the delirium at night.

These two forms of traumatic delirium, the inflammatory and the irritative, are often found more or less conjoined ; a modification of the treatment then becomes requisite,—the surgeon depleting with one hand, and allaying irritation by opiates and giving support with the other.

LOCAL EFFECTS.—The *Direct Local Effects* of injury comprise *Contusions, Wounds* of all kinds, *Fractures, and Dislocations* ; these we shall immediately proceed to consider.

The *Remote Local Consequences* of injury are not so obvious. But there can be little doubt that many structural diseases owe their origin to this cause. The nutrition of a part may be modified to such an extent by a blow or wound inflicted upon it, as to occasion these alterations in structure which constitute true organic disease. Thus we occasionally find, on death resulting some months after a severe injury, that extensive local mischief, usually of an inflammatory character, is disclosed, which has evidently been going on in an insidious manner from the time of the accident.

In other cases again, a blow may give rise to severe and long-continued neuralgic pains in a part, or it may be the direct occasioning cause of structural disease in bones, joints, or blood-vessels ; and, lastly, the origin of many cases of cancer can be distinctly referred to external violence.

under the skin, in which state it may remain for weeks or even months without undergoing any material change, provided it be excluded from the air. In other cases it gradually becomes absorbed; or, if it communicate with the air, the bag being opened in any way, it may undergo disintegration, suppuration taking place within or around it, and the clots discharging through an abscess. In some cases it would appear, from the observations of P. Hewett and of Paget, that the clot resulting from extravasated blood may become organised and finally penetrated by blood-vessels. The French pathologists have described the formation of a cyst containing serous fluid in the site of the extravasated blood. These cysts are composed of a fibrous structure, but without cells; they have no distinct lining membrane, and in their interior serous or grumous fluid, composed of disintegrated blood, is found. In other cases the serous or fluid parts are absorbed, and the fibrinous matters, forming cheesy concretions, are left behind. Lastly, extravasated blood may give rise to a sanguineous tumour, *Hematoma*, the blood—continuing for months, or even years, fluid, but still not unchanged—becoming darker, treacly, and more or less disintegrated, and eventually intermixed with various products of inflammation.

In the third and fourth degrees of contusion, the laceration and disorganisation of structures usually lead to sloughing and suppuration, or to rapid gangrene of the parts, or to hemorrhage, ending in fatal syncope; or, when the contusion is of an internal organ, this hemorrhage may prove fatal by taking place into the serous cavities. When the contusion is superficial, the hemorrhage is subcutaneous, and, though abundant, is rarely in sufficient quantity to influence the heart's action. In one remarkable case, however, in which a schoolmaster was convicted of manslaughter for beating a boy to death with a stick, and in which I was called to make a *post mortem* examination, death had evidently resulted, in a great measure at least, from this cause: the subcutaneous cellular tissue of the four limbs being extensively torn away from the fasciæ, and uniformly filled with extravasated blood, whilst the internal organs were in an anæmic condition, the pulmonary vessels and the coronary arteries of the heart even being emptied of blood.

DIAGNOSIS.—This is not always easy. The minor degrees may be mistaken for incipient gangrene, the discoloration not being very dissimilar; but the part, when simply contused, preserves its temperature and vitality. In some cases the extravasated blood has a hard circumscribed border, and is soft in the centre, thus resembling somewhat a depression in the subjacent bone. This is especially the case in some bruises about the scalp.

The diagnosis of old cases of extravasation, leading to hematoma, from abscess or malignant disease, is not always easily made by tactile examination only; but the history of the case, exploration with a grooved needle, and examination of the contents of the tumour under the microscope, will always clear up any doubt that may exist.

TREATMENT.—In the first two degrees of contusion our great object should be to excite, as speedily as possible, the absorption of the extravasated blood. Here cold applications are of especial service; lotions composed of one part of spirits of wine or of tincture of arnica to eight or ten of water should be constantly applied. Of the value of arnica in these cases I entertain no doubt; I have employed it largely in the most extensive extravasations, and have rapidly promoted their absorption by its use. Leeches—so commonly used in these cases—should not be applied to a bruised part; they cannot remove the blood that has already been extravasated, and often set up great irritation, which leads to suppuration. The bag of blood should

free end is carried with a needle: the thread is then slowly untwisted, and the ring is thus carried upon it off the finger. Curtain or other brass rings compressing the root of the penis have been known slowly and gradually to cut through the organ, without destroying its vitality or rendering the urethra impervious. But such a fortunate result is altogether the exception; in the great majority of such cases, unless the ring be speedily cut off, mortification of the organ would ensue, and might be followed, as it has been in some instances, by the death of the patient.

WOUNDS.

A *wound* may be defined to be a solution of continuity suddenly produced by the incision, rupture, or fracture of a part.

Surgeons universally divide wounds into *Incised, Lacerated, Contused, Punctured, and Poisoned*.

INCISED WOUNDS.—These may vary in extent, from a simple superficial cut, to the incisions required in the amputation at the hip-joint. Incised wounds are usually open, communicating freely with the air, occasionally, however, when made by the surgeon, they are subcutaneous, only communicating externally by a small puncture. They may be simple, merely implicating integument and muscle; or they may be complicated with injury of the larger vessels and nerves, or of important organs.

Symptoms.—In all cases they give rise to three symptoms; viz., Pain, Hemorrhage, and Separation of their Sides.

The *Pain* in an incised wound is usually of a burning, cutting, or smarting character. Dr. J. Johnson compared his own sensations to the pain produced by a stream of melted lead falling upon the part. Much depends, however, on the extent and the situation of the wound; and also whether the cut is made from the cutaneous surface inwards, or from within outwards: being greater in the former than in the latter case, owing to the section of the nerves being made from the branches towards the trunk. When the cut is from within outwards, the trunks being first divided, the branches are paralysed, and do not feel the subsequent incisions.

The amount of *Hemorrhage* necessarily depends upon the vascularity of the part, as well as on the size of the wound. The proximity of the part wounded to the centre of the circulation, or to a large vessel, also influences this very considerably—different parts of the same tissue bleeding with different degrees of facility. Thus the skin of the face pours out more blood when cut than that of the leg. The same parts will, under different states of irritation, pour out different quantities of blood. Thus the tonsils have bled, after their excision, to such an extent as to occasion death, although usually but a few drops are lost.

The *Separation of the Lips* of the wound depends on their tension and the position of the part, as well as on the elasticity and vital contractility of the tissues. It is greatest in those parts that are naturally most elastic or that possess the greatest degree of tonicity; thus the muscles, when cut, will retract to a distance of some inches; so also the arteries and skin gape widely when divided; whereas in the ligaments, or bones, no retraction takes place.

Union of Incised Wounds.—Incised wounds may unite in the five following ways:—1, by the Direct Growing Together of their opposed surfaces; 2, by Scabbing; 3, by the opposite surfaces uniting through the medium of Coagulable Lymph; 4, by Granulations springing up from the sides and bottom, and covering themselves with an epithelial coating; and 5, by the Growing Together of two Granulating Surfaces.

1. The *Direct Growing Together of Opposite Surfaces* was termed by Hunter

injury; the reparative material, "nucleated blastema," not being an inflammatory product.

3. *Union by the Adhesive Inflammation*, the "*union by the first intention*" of modern surgeons, or "*primary adhesion*," as it is termed by Paget, consisting in the effusion of lymph between the opposed surfaces, is more frequently obtained than the direct union. In order that it should take place, the following conditions are necessary:—1. That the patient's constitution be in a healthy state; 2. That the inflammation be restrained within such bounds as suffice for the production of lymph, but are insufficient for the destruction and degeneration of the newly formed lymph, and its conversion into pus; 3. That the wound be closed, its sides brought into accurate apposition, and the air excluded; 4. That the interposition of all foreign bodies be carefully guarded against. Blood acts as a foreign body, and prevents the coalescence of the lymph pressed out from the opposite sides of the wound; hence it is of the first importance that no blood be interposed between the opposite sides of the wound; and adhesive union will be greatly facilitated by all oozing being allowed to cease, and by the surfaces being allowed to become glazed by the exudation of lymph for some hours before they are brought in contact. If any blood be interposed, it acts as a barrier to the cohesion of the opposite layers of plastic matter, invariably becoming disintegrated, breaking down, and being washed away by the suppuration excited by its presence; hence, in the dressing of surgical wounds, such as stumps after amputation, in which it is desirable to procure union by adhesive inflammation, the cut surfaces should not be brought together for a few hours, until all oozing of blood has ceased, and the fibrinous layer thrown out.

The union by adhesive inflammation in an incised wound takes place in the following manner. After all hemorrhage has ceased, the surface becomes "*glazed*," being covered with a film of fibrine of the liquor sanguinis, with which a large quantity of white corpuscles are found intermixed; a sero-sanguinolent fluid draining away. This layer of fibrine rapidly becomes thickened by the deposit of exudative matter, and ultimately becomes vascular, undergoing development into fibro-cellular tissue, which constitutes the bond of union, its exposed surface becoming gradually covered by an epithelial layer, as has already been described in speaking of the development of lymph and its cicatrization. The adhesive layer forms with varying rapidity on different surfaces; thus in a stump, after amputation, it will be found that the muscles, fasciæ, and cellular tissue are covered with fibrine in the course of a few hours; it is not until about the third or fourth day that the subcutaneous fat becomes coated in the same way—and eight or ten days elapse before the adhesive lymph is thrown out upon the cut surface of the bone; and here it shows itself first on the medullary canal, afterwards on the cancellous texture, and lastly upon the hard bone.

For the production and organisation of this lymph a certain amount of inflammation is absolutely necessary, but the inflammation must be confined within proper limits. An inflammation that is too intense, or too long continued, is destructive to the adhesive process. If too violent, the adhesive will pass into the suppurative inflammation; and if too long continued, the development of lymph will be interfered with; for, though inflammation be necessary for the formation of the bond of union, none is required for its organisation, or for its ultimate development into fibro-cellular tissue. (The subject of adhesive inflammation is fully treated at pp. 83 to 86.)

4. *Granulation*.—In those cases in which union by direct cohesion or by the adhesive inflammation fails, in consequence of the broken state of the

between the lips of the wound. In doing this, care should be taken not to wipe the wound too roughly; a piece of soft lint, a triangular bit of sponge, or a stream of cold water poured over the surface, should be the means employed.

The last and most important indication to fulfil, is the *Coaptation of the Opposed Surfaces* as accurately as possible. This can only be maintained by attention to position, and by the application of sutures, plasters, and bandages.

As a general rule, the sides should not be brought together until all hemorrhage has ceased. If, however, there be but slight oozing, this may be arrested by the approximation of the surfaces. If the wound be extensive, it may be advantageous to wait for a few hours, until its sides are glazed over by a layer of fibrine. The parts should now be brought gently into contact, due attention being paid to relaxing them as much as possible by position, so that there may be no gaping of the lips, nor tension on the sides of the wound. They must be kept in place by sutures, plasters, and bandages.

Sutures are commonly employed when there is more tendency to gaping than can be overcome by position or plasters. The material that is generally used for this purpose is well waxed dentist's or twisted silk of various degrees of fineness, introduced by means of a curved needle. In certain operations, more especially in those of a plastic nature, where the suture has to remain in the tissues for many days, and in which, if thread or silk be used, the material would either decompose or inhibit the secretions of the part or wound, and thus become a source of irritation acting like a seton, various metallic wires, of gold, silver, iron, or lead, are occasionally employed with advantage, instead of silk. Well-annealed silver or iron wire is that to which most surgeons give the preference. I know, however, of no material equal to fine telegraph wire, which has been introduced into surgical practice by Mr. Clover. This is composed of a fine copper-thread coated with gutta-percha. It is soft, flexible, tough, and perfectly unirritating, so that it not only admits of ready introduction and knotting, but may be left in the tissues for ten or fourteen days without producing any inflammation or suppuration along its track. In wounds of the limbs, especially in those cases in which some traction may be expected, the suture should be thick; whilst in those cases in which it is of importance that as little deformity as possible be left, it should consist of the finest material that is compatible with the requisite strength.

Sutures may be of various kinds: the *interrupted*, consisting of a number of single stitches, applied at distances varying from half an inch to an inch and a half, is the one most commonly had recourse to in all cases involving the integument. In applying this suture the needle should never be carried deeper than the integumental structure, except in some of the parts about the face, such as the lips and eyelids. The suture should be tied by means of the reef-knot, and the ends be cut short.

The *continuous* suture, never used on the cutaneous surface, is principally employed in incised wounds of the intestines.

The *quilted* suture is applied in cases, as in rupture of the perineum, in which the sides of a deep wound are required to be brought into contact throughout. It consists of a double interrupted suture passed deeply, and tied tightly over pieces of elastic bougie, laid parallel to, and at the distance of half an inch from, the edges of the wound.

The *beaded* suture is rarely employed at the present day: in it the knot is made over a large bead, or a split shot, strung upon each side of the suture, which thus diffuses the pressure over a greater extent of surface.

The *twisted* or figure-of-8 suture is very commonly employed in surgery;

pressure is exercised upon it from the very first. This requires to be done carefully and with due attention to the proper support of the deeper parts, lest infiltration of sero-sanguinolent fluid occur in them, which will readily lead to suppuration.

Union may be readily accomplished in many slight incised wounds, by covering the edges of the cut with a piece of soft lint soaked in collodion, direct cohesion, by a process analogous to scabbing, taking place under the dressing.

If union by the first intention fail from any local cause, or if the wound occur in such a constitution that it is useless to attempt it, inflammation takes place in and around it; the lips swell and become red; a sero-sanguinolent discharge, gradually assuming a puriform character, exudes; and, at the same time, if the wound be an extensive one, suppurative fever sets in. Under these circumstances, the sutures should be immediately removed. the strips of plaster, if continued, should be used merely for support and not for union; a large soft linseed-meal poultice, or a thick piece of warm water-dressing, should be applied; and the patient put upon a moderate antiphlogistic regimen. When suppuration has fairly set in, and granulations have sprung up, the treatment must be conducted in accordance with those general principles that guide us in the management of ulcerated surfaces. The suppuration must be moderated, the process of cicatrization facilitated by the application of a bandage, the general health attended to, and the strength of the patient supported.

Union by "secondary adhesion" may sometimes be accomplished, after that by the first intention has failed, by bringing the granulating surfaces together a second time by means of sutures, harlequin pins, or plasters.

Faulty Cicatrices often give rise to great disfigurement, and require some operative means to remedy this inconvenience. These *plastic operations* will be described more fully hereafter; but it may be stated here that much benefit will occasionally result from excising the cicatrix, and then bringing together the opposite edges of the wound in a uniform line. Should it be too large for this, if flat, it must be left; but if angular it may be divided down to the sound structures beneath, and the gap thus resulting filled by a flap of integument dissected up from the neighbouring parts and twisted into it.

CONTUSED AND LACERATED WOUNDS.—These may be defined to be wounds that are conjoined with more or less bruising about the edges and sides; presenting every possible variety in the degree of contusion and of wound, from a cut on the shin to a limb crushed and lacerated by a cannon-shot. They are commonly inflicted by blunt cutting instruments, as by a hatchet, or by stones, bludgeons, &c. Lacerations by machinery, in which parts are torn off or crushed, the bites and gorings of animals, and gun-shot injuries of all kinds, come under this denomination.

Characters.—Whatever their mode of infliction, these wounds present certain characters in common, by which they differ from all other injuries. Their lips are irregular and torn, less gaping than in incised wounds, but surrounded by more or less ecchymosis and contusion, with a tendency to slough at their sides. There is usually but little hemorrhage, and the pain is of an aching or dull character. In consequence of the sloughy state of the lips and sides, these wounds always unite by the second intention.

Contused and lacerated wounds present peculiarities according to the mode of their infliction.

When they are occasioned by the bite of a large animal, the part injured becomes very painful, and inflames extensively; the wound being lacerated,

muscle continued, and often penetrating deeply. It sloughs in consequence of the pressure to which it has been subjected, and of the animal having shaken and torn the part seized. When the wound is inflicted by the tusk or horn of an animal, it is extensively lacerated rather than contused, and often partakes of the nature of a punctured wound.

When a part of the body is torn off, the wound presents peculiar characters; which differ, however, according as the separation is effected at the part struck or seized, or at a distance from it.

In the first case—as when a cannon-ball carries off a limb, or an arm is caught in a steam-mill or rag-tearing machine and crushed or torn off—the stump presents a very ragged surface, the skin being stripped away higher than the other parts, the tendons hanging out, and the bellies of the muscles that are torn across being swollen, protruding, and apparently constricted by the lacerated integument. A most important condition in these wounds is the state of the vessels; these are separated lower down than the other parts, for, being elastic, they elongate and pull out before they give way. There is no hemorrhage, because the inner and middle coats of the artery, being off short, retract and contract to a small aperture, and allow the external one to be dragged down and twisted over its mouth in such a way as to offer a complete barrier to the escape of blood. The bone is crushed off at the end of the stump, of which it forms the irregular conical apex, and is then split up to the next joint above.

Occasionally, when parts are pulled off, they are separated at a distance from the point seized. Thus, fingers that have been torn off by machinery have their extensor tendons separated higher up, at their junction with the body of the muscle, and not at the part seized; the tendon being drawn out to its length, and hanging on to the separated end in a ribbon-like manner.

In the *Treatment* of a contused or lacerated wound there are two distinct processes—1, that of the Separation of the Slough produced by the contusion; and 2, that of Repair by Granulations of the chasm left. These processes are analogous to those which occur in ulceration, and are fully described at pages 96 to 98.

The *Extent of the Slough* depends not only upon the extent and severity, but also upon the situation of the injury. If the parts around the wound be much bruised, then superficial sloughing to a great extent may occur; if the wound be deep though not extensive, there will always be danger of deep-seated sloughing, leading to deep suppuration and burrowing of matter, and in some cases to secondary hemorrhage. Those wounds that are situated immediately over bony points—as the shin and elbow—are especially dangerous, as the slough frequently implicates the fasciæ. The scalp has a less tendency to slough than any other part of the cutaneous surface. This is owing to its great vascularity, and to the large supply of blood which it receives from nearly adjacent arteriæ. In all cases of contused and lacerated wounds—but more especially in those of the scalp—there is great danger of the development of erysipelas.

But the chief danger to be apprehended in wounds of this description is the development of *Traumatic Gangrene*, which may occur in three ways.

1. The contusion always kills a thin layer of tissue, which forms a slough on the skin or lips of the wound; but in some cases the violence done to the part is so great as directly to kill its whole substance. Thus, if a limb be crushed to a pulp by machinery, or by the passage of a heavy waggon wheel, all circulation is completely and at once arrested, the vitality of the part destroyed outright, and it will speedily fall into a state of putrefaction and decomposition, with all the usual signs of advanced mortification.

If the violence be not quite so great as this, the vitality of the part may be so lessened, and its resisting power diminished to such an extent, that the inflammation necessary for the repair of the injury terminates in gangrene. This is a local traumatic mortification, evincing no disposition to spread beyond the part injured, but being bounded by a line of demarcation along which it will separate. It is not always easy to distinguish this direct form of gangrene from such discoloration and disorganisation of a limb as is still compatible with life. In all cases of doubt the surgeon must wait, and a very short time—a few hours—will be sufficient to declare whether the vitality of the part can be maintained or not. In cases of much doubt an incision might be made into the part, and the true state of things thus ascertained. But this should not be done if it can possibly be avoided.

2 The injury may be chiefly inflicted upon the great vessels of the limb, damaging them to such an extent as to interrupt completely the circulation, gangrene being thus induced indirectly in the parts supplied by them. This form of gangrene we shall have occasion to treat of fully when speaking of Injuries of the Arteries.

3. The true traumatic or "spreading gangrene," the most fatal variety of mortification, is most commonly the result of severe contused and lacerated wounds, particularly when complicated with fractures. It has a tendency to spread rapidly, especially through the cellular planes of the limb, often involving the whole member in less than twelve hours after its invasion.

The true *Spreading Traumatic Gangrene* is invariably of the dark and humoral kind. In it, death of the tissues and their putrefaction are contemporaneous. The putrefactive process does not take place in this, as in the other varieties of gangrene just described, some hours, or days even, after the cessation of vitality in the part; but the purplish-black colour, the fætid odour, and the development of gas, occur at the moment of the death of the tissues, and are evidently dependent on some peculiar septic condition of the parts attacked by the disease. It differs from the other varieties of gangrene in having no disposition to limit itself by a line of demarcation, as well as in the rapidity of its extension and the speedy putrescence that occurs in the part attacked.

The *Causes* of this form of traumatic gangrene are local and constitutional combined. The *Local Causes* consist of injuries of some descriptions, more particularly contused and lacerated wounds of the hand or foot. As a general rule it may, perhaps, be stated that the more severe forms of injury of this description, more especially such as implicate joints or bones, are more liable to be followed by this form of gangrene; but it would be an error to suppose that severe injury is a necessary precursor of it. Comparatively slight injuries, provided they be of the nature of lacerated wounds, have not unfrequently been the occasioning cause of traumatic gangrene of the worst form.

The *Constitutional Condition* of the patient is undoubtedly the main cause of the supervention of spreading traumatic gangrene. However severe an injury may be, and however certainly it may kill those tissues or that part of a limb which are directly and immediately exposed to the operation of the external violence, the rapidly spreading form of the disease will not supervene unless the constitution be in an unsound state; and this remark applies necessarily with especial force to its occurrence after the slighter forms of injury. The supervention of spreading traumatic gangrene will occur under circumstances similar to those which dispose to pyæmia, erysipelas, elonging phagedæna; and, in fact, to the low and diffuse inflammations generally, consisting of imperfect and faulty hygienic conditions, and an

The constitutional symptoms are throughout of the lowest ataxic type, and death almost invariably ensues in from three to four days after the invasion of the disease, and always very shortly after the gangrene has reached the trunk.

Treatment of Contused and Lacerated Wounds.—In the treatment of the slighter form of these injuries, we must bear in mind the occurrence of the two distinct periods: 1, that of sloughing; and 2, that of granulation. There is also in all injuries of this description a special tendency to the occurrence of erysipelas and allied diseases.

Care must be taken to clean the parts thoroughly from foreign bodies that are frequently impacted or ground into them. However contused and torn a flap of skin may be, it should, as a general rule, never be separated, provided it maintain any attachment to the neighbouring tissues, but always be replaced on the chance of its vitality being preserved. If it live, as it will often do, especially about the scalp, under apparently the most discouraging circumstances, much will be gained; if it slough, no harm can result from the attempt to preserve it. There are even cases on record in which parts that have been completely separated have become attached, by being immediately reapplied to the surface from which they had been torn. Whether thus be actually the case or not, it is at all events certain that a very small tongue of skin is sufficient to maintain the vitality of a part. Thus we see exemplified in the operation for the restoration of a lost nose; and cases have occurred to me in which the nose, nearly cut off, being only retained by a portion of one ala, has readily united on being replaced, so likewise, in bad cases of compound dislocation of the fingers, the part has been saved, though merely attached by a narrow bridge of skin. After a part has been replaced in this way, it should be retained *in situ* by a few points of interrupted suture, with a piece of lint soaked in collodion applied to the line of wound. The sutures must be left in for a somewhat longer time than usual, until good union has resulted.

In ordinary cases of contused or lacerated wounds, whether superficially extensive or deep, we must facilitate the separation of the sloughs by the application of *poultices*, which also serve to subdue local inflammation. About the period at which the slough begins to be loosened, there is danger of the occurrence of hemorrhage, if a large artery have been implicated in the injury. When hemorrhage occurs in this way, it usually sets in from the sixth to the twelfth day, and may be speedily fatal. After the sloughs have separated, an ulcer is left, which must be treated on general principles.

Amputation.—In the more severe cases of contused or lacerated wounds, any attempt at saving the part may be hopeless, and the patient's only chance lies in *amputation*. In determining the expediency of operation, two questions present themselves: 1, the nature of the cases in which amputation should be performed; and, 2, the time at which it should be done, whether immediately after the infliction of the injury, or subsequently.

It is difficult to lay down more than very general rules as to the kind of cases that *require amputation*; so much depending on the age, constitution, and previous habits of the patient. In all cases, the surgeon should be careful not to condemn a limb that admits of a fair chance of being saved, and, if the patient should happen to die, as he often may, from the after-effects, such as erysipelas or phlebitis, of a contused wound that admitted of a fair prospect of recovery, the surgeon may justly console himself with the reflection that, with the constitutional disposition leading to these diseases, the injury inflicted by the amputation would in all probability have been equally fatal, and that thus the patient has been

avoid the pain of an operation that would have been unsuccessful in its result.

As a general rule, severe injuries are more readily recovered from in the young than in the old, their vitality and elasticity of constitution being greater, with less tendency to consecutive diseases. Much will depend upon the habits of the patient, or upon the existence of visceral disease at the time of the injury. In persons who have been free livers, and who have that peculiar irritability of system conjoined with deficient power so commonly observed in such subjects, and more especially if there be already existing disease of the liver or kidneys, contused and lacerated wounds are apt to be followed by the worst forms of erysipelas and traumatic gangrene, and thus to be speedily fatal. Injuries of the upper extremity are less serious than those of the lower; its supply of blood being proportionably greater and more uniformly distributed. In some badly contused wounds, ~~and~~, of the arm and hand, as in bad lacerations with fracture about the shoulder, elbow, or metacarpus, resection of the injured part may be performed instead of amputation of the limb.

Though there may always be this doubt as to the cases that should not be amputated, there are certain conditions in which the surgeon need never hesitate to perform this operation, as the only chance of saving the patient's life. The following are the cases of severe contusion and laceration in which the limb should be amputated—either with the view of preventing the occurrence of gangrene, or in order to remove a mortified part from the body, and thus to save the life of the patient at the expense of the injured limb.

1. If a limb have been torn off by machinery, carried away by a cannon-ball, or cut off by the passage of a railway train over it, the irregular and crushed stump should be amputated, so as to leave a more useful and healthy one to the patient.

2. If the whole thickness of a limb—the soft parts and the bones—be torn apart, disorganised and crushed, it must be removed.

3. If the soft parts be extensively stripped away from the bones, though there be entire, so much sloughing and suppuration would ensue as to leave a useless limb, and amputation should be performed. It is in these cases that it is often especially difficult to estimate the amount of injury that cannot be recovered from, this depending so much upon the age and constitution of the sufferer. I believe that surgeons, in their anxiety to save a limb, often lose a patient under these circumstances. I have more than once had reason to regret having attempted to save limbs injured in this way, and believe that, if the skin of the lower extremity be extensively torn away, and the muscles much lacerated, so as to slough away, there is but little chance for the patient—unless he be very young, and of a remarkably robust constitution—except in amputation. In the upper extremity it is different; there, recovery may take place under the most adverse circumstances.

4. If the bones be extensively comminuted and crushed at the same time and the soft parts are much lacerated, there can be no question about the necessity of removing the limb.

5. No alarm, if the knee be largely opened, with laceration of the soft parts, and perhaps fracture of the contiguous bones, the limb must be amputated. Forcible injuries of the ankle, shoulder, and elbow joints, ~~and~~, as has already been stated, admit of resection rather than of amputation.

6. Bad crushes of the foot have a great tendency to run into gangrene, and hence require amputation. In the hand, on the contrary, very extensive

injuries are often recovered from, without this operation being necessary; and in many cases partial resection may be substituted for it.

7. In those cases in which a large artery, as the femoral, is lacerated at the same time that the soft parts are extensively injured, and the bone fractured, amputation is required in order to prevent the occurrence of gangrene. In the more local form of traumatic gangrene, in which the disease is confined to the part directly crushed and injured, no good can come of delay, and amputation should be performed as soon as mortification has declared itself; and the limb must be removed at a sufficient distance from the seat of mischief. Thus, if gangrene of the foot or ankle come on in consequence of a smash of these parts, the upper part of the leg or thigh should be amputated. When the mortification results indirectly from injury of the vessels, the limb should also be immediately removed in a line with the wound, unless this be too high up; then the most favourable point must be seized, as will hereafter be explained. Amputation under these circumstances is by no means a very unfavourable operation (and it is one that I have several times successfully performed), provided it be done sufficiently early, before the constitution becomes poisoned by the absorption of morbid matters from the gangrenous limb. It is scarcely necessary to warn the surgeon to be certain of the existence of gangrene before he operates; and also that it be not a mere limited slough, but sufficiently extensive to jeopardise the patient's life.

8. In all cases in which the *true traumatic or rapidly spreading gangrene* has set in, the surgeon will be placed in a great difficulty, whichever way he act. If he trust to constitutional treatment, in the hope of a line of demarcation forming, he will almost certainly be disappointed, the gangrene rapidly spreading up to the trunk; and if he amputate, he may probably lose his patient by the stump becoming affected. Yet amputation should, in my opinion, be performed at once. For, although this operation is necessarily very unfavourable when practised in these cases, in consequence of the gangrene not being a local affection, but dependent on constitutional causes, yet it must be remembered that, if the surgeon wait for the line of demarcation or trust to other means, such as incisions or general treatment, the patient will almost to a certainty die. The patient's safety in these cases, then, lies in amputating early, and removing the limb high above the part affected; thus, in spreading gangrene of the arm, at the shoulder-joint; and of the leg, in the upper part of the thigh. The necessity for high amputation in these cases is owing to the gangrene spreading more extensively in the cellular tissue than it does in the skin; and hence in reality invading the limb to a higher point than it appears externally to do. In most cases it will be found that the infiltration precursory to the gangrenous mischief runs up one side of the limb—the inner or posterior—to a much greater extent than the other. In amputating under such circumstances the surgeon may often very advantageously so fashion his flap as to exclude as much as possible of the affected part or side of the limb, forming them chiefly from that least affected. A principal source of danger and of death, after amputation in these cases, is the great disposition to the recurrence of the morbid condition in the stump, more particularly in the lower extremity. Out of twelve cases in which I have seen or done amputation for this disease, this recurrence happened in seven instances. This tendency will be increased by the proximity of the line of amputation to the gangrenous limit. But, even under the most unfavourable circumstances, recovery will sometimes take place. Thus I have seen the flaps in amputation for spreading gangrene *infiltrated with gelatinous-looking fluid*, and yet recovery takes place. In a

man whose arm I amputated at the shoulder-joint for spreading gangrene of the limb, the infiltration had extended as high as the scapula; yet he made a very excellent recovery. In the lower extremity the liability to recurrence of the gangrene is, however, very much greater; and there can be but very little prospect of saving the patient if the thigh have once become relaxed and infiltrated, even though the gangrene do not extend above the knee—invasion of the stump ensuing under such circumstances with almost absolute certainty.

Much of the success of the case will depend on the after-treatment. Light dressings to the stump, the administration of full doses of liquor opii, and the early and free administration of stimulants, more particularly brandy and wine, are the principal points to be attended to; and attention to these will often bring the patient through, though usually not without much difficulty and great constitutional disturbance.

The next question, as to the period at which amputation should be performed in contused wounds, has already been considered at pp. 31 to 33. It may be generally stated that, the sooner a condemned limb is taken off, the less is the suffering, and the better the chance of recovery to the patient; and that, consequently, primary amputation should be practised in these cases, for, notwithstanding the higher rate of mortality in primary than in secondary amputations, it is absolutely necessary in many cases to remove the injured limb within the first twenty-four hours. This higher mortality may partly be dependent on the accidents that require primary amputation being more severe than those in which it has been thought justifiable to attempt to save the limb, and certainly, of the two alternatives of leaving a badly crushed and mangled limb until suppuration is set up, and thus exposing the patient to all the risks of gangrene, erysipelas, pyæmia, &c., or removing it at once, the latter is the one attended with least danger to the patient.

BRUSH-BURN.—There is a peculiar species of wound, that partakes perhaps more of the character of those that we have just been considering than of any other variety, occasioned by rapid and severe friction of the surface of the body, so that the skin becomes abraded and the subjacent tissues somewhat contused. It goes by the name of a "brush-burn," and is not infrequently produced in the manufacturing districts, by the surface of the body coming into contact with straps or portions of machinery in rapid motion. It has also been known to occur in consequence of a person slipping and gliding rapidly down a long and steep Alpine snow-slope. In this injury the integumental structures are, as it were, ground off, and the deeper and aponeurotic structures converted into an eschar.

The Treatment presents nothing special, but may be conducted on ordinary principles. The separation of the eschars must be facilitated by ever-dressing and poultices, the resulting sores will heal by granulation; and the general health must be supported during the suppurative period and must necessarily remain.

CHAPTER VIII.

GUN-SHOT WOUNDS.

AMONGST the special varieties of contused and lacerated wounds, none are of more interest than the different forms of gun-shot injury. Though comparatively and fortunately rare in civil practice in this country, yet they are of sufficiently frequent occurrence to render an acquaintance with them indispensable to the general surgeon. To the military surgeon their study is necessarily one of peculiar interest and importance; and to him I would specially recommend the perusal of the works of Hennen, of Guthrie, of Larrey, and of other surgeons who have had unusual opportunities of studying the nature of these injuries upon the field of battle, and by whom they have been treated with all the minuteness of a speciality. I purpose in the following observations chiefly to confine myself to such a general discussion of the subject as is required by the civil practitioner.

Gun-shot injuries constitute a species of contused and lacerated wounds, characterised in some cases by the peculiar appearance presented by the colour, shape, and size of the orifice; and in others, by the extensive injury inflicted to parts, both superficial and deep-seated, in consequence of which they may prove immediately or rapidly fatal. If the sufferer survive, high inflammatory action, with much pain and tension, with profuse discharge, deep-seated suppuration, and other after consequences of a serious and very protracted character, are apt to set in. These peculiarities were at different times attributed to the parts being burnt by the ball, to the poisonous nature of projectiles, and to electricity developed by the bullet in its passage through the air, or by its friction against the barrel. All these opinions, however, have been shown to be erroneous; and every peculiarity presented by these injuries can be accounted for by the bluntness of the contusing body, the rapidity of its course, and the force with which it is driven. As John Bell has pathily stated it, "there is a peculiarity, but no mystery, in gun-shot wounds." That the sloughing which always occurs in the track of a bullet-wound is due to the injury being inflicted by a blunt body, is evident, from sharp splinters of shell having been known to inflict clean-cut wounds.

CHARACTERS.—Gun-shot wounds vary greatly according to the Nature of the Projectile, to the Force with which it is driven, and to the Direction in which it strikes.

Nature and Force of Projectile.—Gun-shot injuries of a serious character may be inflicted by *weapons charged only with powder*. This may injure by the mere concussion of the explosion; thus a pistol charged with powder, and discharged with the muzzle resting against the chest of a man, has been known to kill by concussing the heart. In other cases, a portion of the unexploded powder may be driven into or through the skin by that which is exploded behind it. In this way very troublesome and disfiguring marks are not unfrequently inflicted on the face, and other parts of the body, by the charcoal of the powder being driven into the skin. That a weapon so charged may actually kill, appears from a case related by Dupuytren, in which a fowling piece charged with powder only, and fired at the distance of two or three feet from the abdomen, pierced the belly with a round hole and killed the man. The force of the explosion only will sometimes produce *serious lacerations*. Suicides occasionally forget to put a bullet into the

pistol, and, discharging it into their mouths, blow open the cheeks, and rupture the pharynx and glottis by the explosive force. Some years ago, a man was brought to University College Hospital, who had discharged the tube of an *Italian iron*, loaded with powder only, into his mouth, and died in consequence of the injuries he received. In another case in the same institution, a man died of asphyxia on the fifth day after firing a pistol into his mouth, from sloughing of the pharynx and inflammation of the glottis and larynx, consequent on the scorch of the explosion.

Hard and soft materials, as pieces of clothing, will occasionally inflict serious wounds by the force with which they are driven. These injuries often happen on the stage, at reviews, fairs, &c. Taylor relates several instances of the kind:—that of a girl killed by a gun charged with paper pellets; also, that of a man who was killed by a kid glove fired from a blunderbuss.

Shot most often inflicts serious injuries, and these are most commonly met with in civil practice. If the person wounded be within a few feet of the muzzle of the gun, a terribly torn and lacerated wound, of a very serious character, even worse than that occasioned by a bullet, will be inflicted; for the shot, not being scattered, are driven through the body in a solid compact mass, tearing the tissues to a great extent.

When shots scatter as they fly, they produce at a greater distance a less serious injury, usually lodging in the subcutaneous cellular tissue, where they may remain for years, requiring to be picked out with a lancet; or they may give rise to suppuration. Occasionally shot, by penetrating an important part, may cause serious or fatal results; thus, a single shot penetrating the eyeball will destroy vision; or, lodging in the heart or in the femoral vein, may give rise to rapidly fatal results. A patient was brought to University College Hospital, who had fired a pocket pistol loaded with small shot into his mouth; after death, the shots were found to be deeply lodged in, and to have penetrated the anterior portion of, the vertebral column.

Splinters of various kinds, of shells, of metal, wood, or stone, carried by the force of the explosion, as in blasting and mining operations, inflict perhaps the worst forms of gun-shot injury that are met with in civil practice. In siege operations much injury also is often inflicted by the splinters from parapets, or the forcible throwing up of gravel and small stones by the explosion of shells. In naval actions, the force with which splinters of wood are driven, when struck and scattered by cannon shot, is so great as to inflict the most serious and fatal mischief. A particular form of injury not unfrequently met with in civil practice, and which belongs to this class, is the wound of the right eyeball by the explosion and splintering of faulty percussion-caps.

Repeating, shell, and grape-shot occasion more serious wounds than any that have yet been described: lacerating soft parts, fracturing and crushing bones, tearing arteries and nerves, perforating the viscera, and occasionally cutting off parts, as a finger, the nose, or an ear.

The general introduction of rifled firearms into modern warfare has greatly increased the destructive effects produced by bullets. The missile seldom falls, if ever, deflected from its course by the resistance offered by bone, tendons, or the elastic reaction of the skin, as happened with the smooth-bore ball; but penetrates in a straight line from the point struck, tearing through the soft parts, and splintering the bones widely. On the bones the modern conical cylindrical bullet produces the most destructive effects, not only comminuting the part struck, but often splitting up the shaft of the bone, by its wedge-like action, in fissures many inches long, passing into contiguous joints. In consequence of this greater and more

sudden disorganisation of the soft parts, the shock to the nervous system is greater when a person is struck by a conico-cylindrical than by a round ball.

Direction.—In the majority of cases, a bullet traverses, and the wound has two apertures, one of entry, the other of exit; occasionally it happens, however, that in consequence of the ball being spent, or of the piece not having been efficiently loaded, or of the oblique direction with which the ball strikes the part, it merely leaves a contusion or dent, rebounding or glancing off. In other cases there is only one aperture; and here the bullet, partly spent, has probably lodged in the soft tissues, in a bone, or in the cavity of a hollow organ, as the bladder. It sometimes happens, however, that the ball drops out through the aperture at which it entered, as when a spent ball strikes a rib; or, that it carries a pouch of clothing before it, which enables the surgeon to withdraw it. One bullet may even make more than two apertures: thus, a ball has been known to split against the sharp edge of the tibia, and to have one aperture of entry and two of exit; or it may pass through both thighs, or both calves, and thus occasion four apertures; and cases have been recorded in which five wounds even have been made in the same person by one bullet. Conical balls, as has been already observed, tear their way through the strongest and densest osseous structures.

The direction of the openings is often of importance, in a medico-legal as well as in a surgical point of view. Thus, Sir Astley Cooper, by attending to this circumstance in a case of murder, ascertained that the fatal shot must have been fired by a left-handed man, and thus led to the detection of the criminal. These apertures, though usually opposite to one another when a ball traverses, will sometimes take a very remarkable course, the bullet being deflected by meeting with obstacles from bones, or by the elasticity of the skin. Thus, a bullet has been known to strike a rib and to be deflected, running under the skin to the opposite side of the body; so again, striking one temple, it has been carried under the scalp to the other side of the head, where it has passed out; thus appearing to have penetrated important cavities which in reality were not wounded.

The *Apertures of Entry and of Exit*, made by a bullet, deserve attentive consideration. Much discussion has arisen as to whether there be any difference between these



Fig 54.—Gun shot Wound. Aperture of Entry



Fig 55.—Gun-shot Wound. Aperture of Exit.

apertures, and, if so, to what it is owing. That there is a difference in the great majority of cases, there can be no doubt; the hole made by the entrance of the ball being small, depressed, and circular, scarcely admitting the introduction of the little finger (Fig. 54); whilst that made by its exit is a large, somewhat everted, and irregular aperture, into which two or three fingers may be freely passed (Fig. 55).

In some cases, however, there is no appreciable difference between the two, and in others, after a time, the aperture of entry is larger than that of exit.

There can be no doubt that Mr Guthrie has given the correct explanation of these discrepancies, when he states, that the amount of the difference in the two apertures will depend partly on the momentum of the ball, and partly on the resistance with which it meets. If the ball strike shortly after its discharge, at the maximum of its velocity, it will make but a small round hole, not so much shattering the parts as separating them. If it traverse a part composed of soft tissue, meeting with but little resistance in its passage, it loses but little of its momentum; and, passing out of the body with nearly the same force with which it entered, it makes an aperture of exit that differs but slightly, if at all, from that of entry. If the ball strike a bone on its passage through the limb or body, and thus, by meeting with much resistance, have its momentum materially lessened, the aperture of exit will be torn, large, and ragged, differing materially from that of entry. So also, we find that in all bullet-wounds the entrance-aperture is actually less in diameter than the bullet itself, provided it be made whilst the ball is moving with its full velocity; if it have nearly lost its momentum before it strikes, then the entrance-wound will always be large and ragged. In this there is nothing peculiar to the tissues of the living body; the same happens when any elastic material, as a piece of green timber, is struck. Much, however, will also depend on the period at which the wound is examined. In the early stages, for the reasons mentioned, the wound of entry is smaller than that of exit: but, as the eschar which forms in the wound of entry is larger than that at the exit aperture, the former may, in a later stage, appear larger than the latter. This difference in the size of the two wounds I saw well exemplified in the case of a young man, shot through the neck in a duel. The aperture of entry, which was at first the smallest, appeared on the second day the largest, in consequence of the extrusion of a black eschar; though it continued more regular in shape than that of exit.

Gun-shot balls inflict two kinds of injuries. They may contuse a part deeply, crushing muscles and bones, without destroying the integrity of the skin, the ball either having lost its velocity, and being spent, or striking obliquely, or rolling over the surface of the body. The elasticity of the skin preserves this from injury, though all the subjacent textures—bones, muscles, and vessels—may be totally disorganised and crushed into a pulp, if a limb be struck; if the trunk itself be injured, the vertebral column and lumbar vertebrae may be disorganised, and the liver, kidneys, spleen, stomach, and intestines ruptured, without any breach of surface. These injuries, formerly erroneously attributed to the action of the current of air set in motion by the ball, &c. by the name of *wind contusions*. In some of these contusions gangrene of the limb sets in, apparently, as Mr. Guthrie has pointed out, from the rupture of the principal vessels.

Gun-shot balls more commonly carry away the whole thickness of a part, wounding and shattering a limb, carrying off the thick and fleshy parts of arm, calf, or shoulder, or they may inflict the most fearful injuries, by passing the trunk and head.

Symptoms.—The chief peculiarities of gun-shot injuries consist in the amount and character of the Pain, the severity of the Shock, the comparatively little liability to Hemorrhage, and the severity of the Consecutive inflammation.

The *Pain* in gun-shot injuries varies greatly. It is most severe when a bone is fractured, or a large cavity penetrated; when soft structures also are exposed, a dull and heavy sensation is experienced, which has often been compared to that occasioned by a blow with a stick. In many cases when the wound is severely engaged, as in the height of action, no pain is expe-

menced, and the sufferer does not know that he is wounded until he is told so, or sees the blood.

In gun-shot injuries, the *Shock to the Nervous System* is always very great where parts of importance, as the head, chest, and abdomen, or large joints, as the knee, are opened; and the severity of the shock is indicative of the amount of mischief inflicted. As has already been stated, the shock is more severe when a wound is inflicted by conical bullets from a rifled musket, than when made by spherical balls from the old smooth bore. Thus, if a bullet appear to have traversed the chest, but in reality has been deflected under the skin, the comparative absence of shock will serve, to a certain extent, to prove that visceral mischief has not been inflicted. In some cases, the shock alone appears sufficient to kill; thus, a man shot by a pistol-bullet, which traversed the distended stomach, died in a few seconds from shock, there being no bleeding of importance, or other discernible cause of immediate death (Taylor). In some cases, however, that are mortal, the symptoms of shock are but slight. It often happens that, in the heat of action, a soldier is wounded without being aware of the hurt until he sees or feels the blood trickling. Hennen has known a limb carried off or smashed to pieces by a cannon-shot, without the sufferer being conscious of it; and Macleod relates the case of an officer who, in the Crimea, had both legs carried away, and who was not aware of the injury he had received till he tried to rise.

The *Hæmorrhage* from gun-shot wounds varies necessarily according to the situation of the injury and the size of the vessels injured; *ceteris paribus*, they bleed less than other injuries; but in all cases a certain, and in many a large and fatal, quantity of blood is lost. When the fleshy parts of a limb are perforated by a bullet, the hæmorrhage is usually very trifling, the vessels divided being of small size, and contused rather than cut across. If the whole of a limb be torn away by a cannon shot, the arteries of the jagged stump left do not bleed, for the same reasons that those of a limb torn away by machinery do not; viz., the contraction and retraction of the internal and middle coats, and the twisting of the external cellular coat over the end of the torn vessel. But, though it may be stated as a general rule that gun-shot wounds do not bleed much, yet when a large artery, as the carotid, iliac, or femoral, is cut across, violent and suddenly fatal hæmorrhage will occur—the vessel bleeding as freely as if divided by the knife. Bullet-wounds of the large and deep arteries of the chest and abdomen are almost immediately fatal, from the hæmorrhage they occasion. The greater number of those who die in the field of battle perish from this cause. It has often been observed that arteries escape, though lying apparently in the direct track of a ball. In such cases, however, though primary hæmorrhage do not occur, the liability to secondary hæmorrhage is great.

Gun-shot wounds always *Inflame*, with much *Swelling* and *Tension* of the part. The pain which, at the moment of infliction, may not have been severe, becomes extremely acute when inflammation has set in, owing principally to the great tension that takes place. This, indeed, is one of the most remarkable phenomena of gun-shot injury, and, by giving rise to strangulation of the tissues, is often the cause of serious mischief. The inflammation speedily terminates in suppuration, often of the most profuse and extensive character, not only in the track of the ball, but widely diffused through the neighbouring parts. A period of great danger in gun-shot wounds is that about which the sloughs begin to separate, usually from the sixth to the twentieth day; and up to this time it is often impossible to know the precise extent of the disorganisation. At this period, also, con-

In general, this may not give much trouble ; but if a large vessel be injured, the loss of blood will rapidly prove fatal, unless immediately stopped. This is done in the first instance by direct pressure with the fingers on the bleeding part, followed by the application of the tourniquet; or, if this instrument be not at hand, of some simple substitute, such as a pebble, of about the size of an egg, rolled in the middle of a pocket-handkerchief and laid over the artery, the ends of the handkerchief being knotted round the limb, and then twisted up tightly with a piece of stick, or the hilt of a sword, passed



No 56.—Gun-shot Wound of Thigh. Mode of compressing Artery.

under it (Fig. 56). The wound in the artery may be of such a kind as to require amputation of the limb ; if not, hemorrhage must be permanently arrested by an incision being made down to the bleeding vessel, and a ligature applied on each side of the wound in it, for reasons that will be fully stated when we come to speak of Injuries of Arteries. In military practice such operations, however, appear to be very rare, and the ligature of a large artery for primary hemorrhage after gun shot injury is scarcely ever practised. The fact is that, if a large artery be wounded, the patient usually dies outright from hemorrhage before anything can be done to arrest the bleeding. If a small vessel only be divided, the hemorrhage will speedily cease of itself.

The next point to be attended to is the *Extraction of Foreign Bodies*, such as shot, slugs, or bullets, wadding, pieces of clothing that have been carried in with the ball, splinters of bone, and other matters of a like kind. These will generally be found near the aperture of exit, through which they may then be more easily extracted.

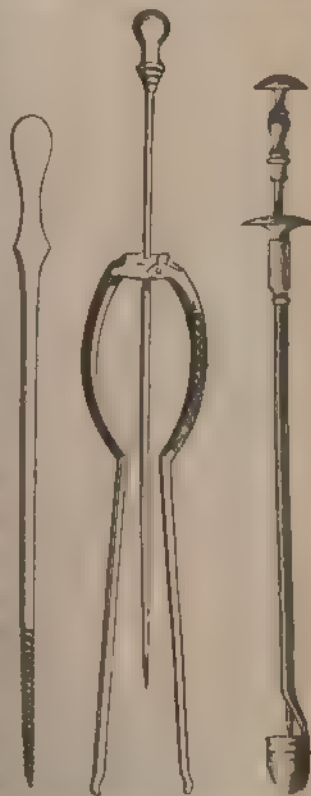
If the bullet lodge, it, together with foreign bodies accompanying it, such as pieces of clothing, must be extracted through the wound, or cut out by a counter opening. This second opening is often of great utility in affording a ready exit for discharge, &c. The extraction of the bullet is a matter of great moment. It should be accomplished without delay, before inflammation has set in, and the lips and sides of the wound have become swollen. As Dr. Macleod justly observes, the extraction of the ball not only removes a source of physical irritation and suffering, but of mental disquietude. The mind of the patient becomes more tranquil and easy. Bullets cannot be allowed to remain lodged in the body with impunity. It is true that in some cases they may become encysted, and so cease to irritate ; but in the great majority of instances they produce suffering and constitutional disturbance, and may at last occasion fatal mischief ; for, although a bullet may continue fixed for years, yet it may at last, under the influence of muscular action, gravity, or the absorption of fat, begin to move and to give rise to injurious consequences. If anything be very tightly fixed, so that it cannot readily be removed, it must be left till loosened by suppuration. Sometimes a bullet is firmly fixed in the cancellous structure of the articular

end of a bone. It may be removed thence by means of an elevator or by the arrow probe. In searching for bullets and other foreign bodies, care should be taken not to probe the wound unnecessarily from mere curiosity, or so as to excite irritation; in many cases, the introduction of the finger is far more useful than that of the probe.

The splinters produced by the passage of a ball through a bone are more numerous and larger, when the injury has been inflicted with a conical rifle-ball. The impetus of this projectile is so great, and its wedge-like action so destructive, that the bone struck is shattered into a great multitude of fragments, as well as split longitudinally, often to a great extent. These fragments are detached to a greater or less extent from their connections with the soft parts, and carried out of the axis of the limb. Dupuytren, who was fond of systematising, has classified splinters of this kind under the three heads of *primary*, *secondary*, and *tertiary*. By *primary* splinters are meant those which are carried completely across the limb, detached from the soft parts, and lodged near the aperture of exit. The *secondary* splinters are those which are still adherent by an edge to a strip of periosteum or to the fibrous tissue; and the *tertiary* are those longitudinal fragments of bone which are not carried out of the axis of the limb. The treatment of these different splinters must necessarily vary. The *primary*, which are already completely detached and are insusceptible of consolidation, must be treated as foreign bodies and extracted. The *secondary*, if very loose, may also be removed, but, if more firmly fixed, they may be pushed into the axis of the injured bone and left. The *tertiary* must of course be left, and will become encased by callus, and so serve in the reconstruction of the bone. Some portions of these, however, will not unfrequently separate at a later period, and, if engaged in, incorporated in a mass of callus, be a very considerable time in separating, keeping the wound open for years.

Various instruments are used for the removal of bullets and other foreign bodies. The simplest are perhaps polypus or dresser forceps. The accompanying woodcuts (figs. 57, 58, and 59) represent the best forms of bullet-wires and forceps. The forceps are usually made much larger and stronger than those in ordinary use.

In those cases in which small shot are forced under the skin, they may be turned out by teasing out down upon with a fine needle.



Figs. 57, 58, 59 — Bullet-wires and Forceps.

The next object should be the Treatment of the wound itself, which must be conducted on ordinary surgical principles. This, as has already been stated, will always inflame violently enough along the whole track of the ball. The principal points to be attended to are, consequently, to limit the inflammation, and to watch and

facilitate the separation of the sloughs, and to pay scrupulous attention to cleanliness.

In order to *limit the inflammation*, it was a common practice with military surgeons, and still is so with the French, to dilate by incision the wound made by the ball, with a view of preventing tension and strangulation of parts. Since the time, however, when John Hunter pointed out that an incision could not alter the nature of a contused wound, and only super-added another injury to the one already inflicted by the bullet, British surgeons have employed the knife, in the early stages of gun-shot wounds, only for the purpose of securing bleeding vessels, or of facilitating the extraction of foreign bodies. In the more advanced stages, however, free incisions, which should be made in the direction of the axis of the limb, are commonly required, in order to lessen inflammatory tension, to prevent the extension of sloughing, and to favour the escape of matter.

The best mode of lessening inflammation in a gun-shot wound in the early stages, and more especially in hot climates, is either by cold irrigation or by the application of dry cold by means of ice in indiarubber bags, conjoined with position and rest; at a later period, water-dressing and poultices will be more useful. As suppuration comes on, we must substitute warm applications for the cold, so as to hasten the formation of matter and the separation of the sloughs. Free incisions may also now be required. These should not be delayed too long. They may be required for two purposes; first, to remove the tension resulting from deep infiltration of the limb by inflammatory effusions, and thus to prevent the strangulation of the tissues, and to remove the severe constitutional reaction that is always consequent to and dependent upon this local inflammatory tension; and secondly, with the view of opening up purulent collections, which often depend upon the irritation of splinters, portions of clothing, and other foreign bodies that could not be removed in the first instance. At the period of the loosening and separation of the sloughs, there is always especial danger of the supervention of consecutive hemorrhage. The patient, consequently, at this time requires to be carefully watched: if the wound be in the vicinity of large vessels, he should have a tourniquet placed loosely round the limb, so as to be screwed up at a moment's notice; and he must, on the supervention of bleeding, have the artery ligatured; if possible, at the seat of the wound; if this be not practicable, in the most convenient situation above it; and if this do not arrest the bleeding, amputation should be had recourse to.

After-consequences of a serious character, such as abscesses, profuse discharges, necrosis, and the separation of splinters of bone, must be looked for in many cases; and these consequences may be prolonged for a considerable series of years, at last perhaps wearing out the patient, if the cause of irritation be not removed. Thus General Bem required to have a bullet removed by Liston from the external condyle of his femur, nineteen years after it first lodged there; and Marshal Mincey died forty years after the receipt of a gun-shot wound, from its effects.

A soldier who was wounded at the storming of the Rolan, died under my care in the University College Hospital, two years and a half after this event, of exhaustion resulting from a large lumbar abscess. On examination it was found that the bullet, which had entered the left side of the chest and wounded the lung, traversed the diaphragm, notched the spleen, passed between the kidney and suprarenal body, and perforated the spine, was lying encapsuled on the right side of one of the vertebrae, pressing upon the right renal vessels. Its irritation, and that of the sequestra from the injured spine, produced the abscess, from the effects of which the patient died.

health of the troops, and partly to the terrible effects of conical balls. In India, where round bullets and matchlock balls are more used, the result is not so bad.

Dr. Macleod states that, although he made every inquiry, he could hear of three cases only in which recovery had, in the Crimea, followed a compound fracture of the upper third of the thigh-bone without amputation. But, exceptional as were such recoveries, he states that they were not so rare as after amputation for similar injuries; as indeed was proved by the fact of not one patient recovering after amputation at the hip-joint. M. Hutin, the surgeon to the Invalides in Paris, was able to discover 24 cases of recovery after compound fracture above the middle of the thigh, but no case of recovery after amputation for injury of the same part. In the British army in the Crimea, the amputations in the upper third of the thigh, which must have been for compound fractures low down in the bone, were fatal, in the ratio of 86 per cent.; of those in the middle, probably for injuries of the lower articular end and knee, 60 per cent. died; whilst of those in the lower third, which must have been for injuries of the knee and leg, the mortality was reduced to 56 per cent. The conclusions at which Dr. Macleod arrives after a careful inquiry into this point, are so important, that I give them in his own words. He says, "Under circumstances of war similar to those which occurred in the East, we ought to try to save compound comminuted fractures of the thigh when situated in the upper third, but immediate amputation should be had recourse to in the case of a like accident occurring in the middle and lower thirds."

3. In gun-shot fractures of the *bones of the leg*, amputation becomes necessary if the tibial arteries be injured, or if the knee or ankle-joints be wounded. If the injury be in the middle of the leg, at a distance from these joints, and provided there be not longitudinal fissuring of the bone leading into them, much may be done to save the limb, by the extraction of splinters, and the removal of sharp and angular fragments of bone. In such cases, the patient may recover with a shortened but otherwise useful limb.

4. Gun-shot wounds of the *foot*, if perforating and splintering the tarsus, require its removal, either at or above the ankle. Those of the *hand* are of special interest from their frequency, in consequence of the bursting of guns, or of powder-flask explosions. In these cases, however extensive the injury may be that is inflicted upon the hand, fingers being blown away, the thumb thrown back, and the metacarpal bones splintered, we must endeavour, if possible, to save a portion of it, if it be only one or two fingers; and, owing to the great reparative power possessed by the hand, we shall often, in the worst looking cases, be able to accomplish this. If the thumb, with one finger as an opponent, can be preserved, it will be of more service to the patient than any artificial contrivance, however ingeniously made (*vide p. 37*). It not unfrequently happens that amputation may be required in the more advanced stages of gun-shot injury, in consequence of mortification supervening. Under these circumstances, it must be practised without delay, and without waiting for the hue of separation. If, in consequence of long-continued suffering and discharge, the patient's health become worn out, and the limb remain a useless appendage, amputation will at last be imperative.

5. Gun-shot injuries of *joints* are necessarily of the most serious and fatal character—the danger depending on the size and complexity of the articulation, rather than on the extent of injury inflicted upon it. Wounds of any of the three large joints of the lower extremity are especially dangerous

and fatal; those of the upper extremity are more readily, and indeed commonly, recovered from. The fact of a joint being wounded is commonly enough from the direction taken by the ball, the comminution of the bones, and perhaps the escape of synovia; but it must be borne in mind, that a joint may be fatally injured by the longitudinal splitting of the bone into it, although the bullet has not passed within some inches of it.

Bullet wounds of the *head, neck, or trochanters of the femur*, splintering the bone into the articulation, are necessarily of the most serious character. If they are left to palliative treatment, the death of the patient may be considered as almost inevitable; if amputation at the hip be performed, the prospect is no better. There is no instance on record of primary amputation at the hip; but having been successful in these or any other injuries. The best hope lies in the excision of the splintered bone, and the careful removal of the bone fragments. This operation, originally proposed by Mr. Guthrie, and first successfully performed by Mr. O'Leary in the Crimean war, presents the only reasonable, though but a slender, hope of safety to the patient, and should accordingly be practised. With this view the wound must be laid very open, loose fragments extracted, and the upper end of the bone washed, turned out, and sawn off. Of six cases in which this was done in the Crimea, but one patient, Mr. O'Leary's, recovered.

Bullet wounds of the *knee joint* are amongst the most serious injuries in surgery, and this whether the bones be much comminuted or not, provided the epiphyses of the tibia or femur be perforated, or the articulation be transversely or even penetrated by the ball. Excision of the damaged joint and bones has not been attended by success; and although it is possible that the records of military surgery might furnish a few scattered instances of recovery after this injury without any operative interference, yet we must look upon such cases as so exceptional, as not to interfere with the rule of amputating in all cases of bullet-wound of this joint. This operation is to be performed early; not because the apparent injury may be very severe, or the mutilation of the limb so great as imperatively to call for immediate amputation, but because experience has shown that, unless the limb be removed at an early period, after consequences of the most serious and fatal character will to a certainty ensue. Extensive suppuration of the joint, deep and large abscesses burrowing amongst the muscles of the limb, and consequent exhaustion of the patient by hectic, or his destruction by gangrene, are the conditions that amputation, performed at an early stage, may avert. This necessity for early amputation in penetrating bullet-wounds of the knee-joint is recognised by all modern military surgeons. In the French wars, Eschscholtz and Larrey in the French wars, Eschscholtz and Stromeyer in the Crimean campaign, and the surgeons in the Crimea, all found that an attempt to save a limb so injured led to the sacrifice of the patient's

wounds of the *ankle-joint* do not necessarily require amputation. If the joint be not too extensively comminuted, and more particularly if the tibial artery and nerve have escaped injury, an attempt, and a successful one, may be made to save the limb; the injury being treated on the principles which will be described in the chapters on *Wounds and on Dislocations*. In such cases extraction of fragments, and of the splintered ends, are necessary. If the large vessels and nerves be cut across, and the bones very extensively shattered, amputation is the proper course to pursue.

Especially in gun-shot injuries of the *shoulder and elbow-joints*, that

conservative surgery has been attended by the most successful results. In such cases as these, when the bones are penetrated and even shattered by a bullet, provided the main blood-vessels and nerves of the limb are not injured, amputation will seldom be required. The wound being enlarged,



Fig. 60.—Bullet in Head of Humerus.

loose spicula must be removed, and the splintered and jagged ends of the fractured bone sawn smoothly off. If the bullet be still lodged in the head of the humerus, as in Fig. 60, the same course should be adopted. The results of these excision operations on the joints of the upper extremity are in the highest degree satisfactory. Thus M. Baudens states that he saved 13 out of 14 cases of excision of the shoulder. According to Mr. Thornton, in the British army in the Crimea, the shoulder was excised 12 times with 2 deaths; the elbow in 17 cases, of which 2 were fatal, and partially in 5 other cases, all of which were successful. These results, which reflect the highest credit on the skill of our army surgeons, were more successful than

those that followed the amputation of corresponding parts. Of 60 disarticulations at the shoulder, 19, or 31 per cent. were fatal; and of 153 amputations of the arm, 29, or 19 per cent. died. In the lower extremity, excisions are not so successful after gun-shot injuries as for disease.

In the Russian army, conservative surgery was also extensively practised; and in it, according to Messrs. Mouat and Wyatt's Report, of 20 cases of excision of the elbow, 15 recovered.

The steps of the operation are the same, whether the excision of the part be required for gun-shot injury, or for other accidents or for disease; except that in gun-shot injury advantage may often be taken of the wound in the soft parts, by enlarging which the shattered bone may be readily reached and extracted, and the splintered ends sawn smooth.

The question as to the period at which amputation ought to be performed after the infliction of these wounds, is one of great importance, and has given rise to a corresponding amount of discussion among surgeons. The older military surgeons, Paré, Wiseman, Ledran, Ranby, &c., taking a common-sense view of the question, advocated the removal of the hopelessly injured limb as soon as possible after the receipt of the injury. Wiseman's advice is to "cut off the limb quickly, while the soldier is heated and in mettle"; and this advice has not been and cannot be improved upon. After the battle of Fontenoy, in the middle of the last century, professional opinion underwent a change upon this subject; and Faure wrote a thesis, which obtained the prize of the French Academy of Surgery, recommending delay in amputating in certain cases. Hunter, Percy, and other surgeons of repute, promulgated similar views; until Bilguer, the surgeon-in-chief to the armies of Frederick the Great, went to the absurd and dangerous extent of condemning amputation entirely. These extreme opinions necessarily occasioned a reaction; and the experience gained in the wars of the French Revolution and Empire, has enabled surgeons to settle this question definitely. It is more particularly by the labours and observations of John Bell, Larrey, Thomson, Guthrie, S. Cooper, and Hennen, that the necessity of having recourse to immediate amputation in all cases of gun-shot injury requiring this operation has been fully recognised, and the truth of Wiseman's advice has been re-established.

In determining this point we must be guided, partly by surgical experience on the result of such cases left to nature, and partly by an appeal to facts.

the wounded soldier is usually exposed from over-crowding and want of necessary appliances. He is thus peculiarly liable to the occurrence of pyæmia, sloughing phagedæna, &c.

The nature and treatment of gun-shot injuries of special regions, as of the head, chest, and abdomen, will be considered in the chapters devoted to the description of injuries of those parts.

CHAPTER IX.

PUNCTURED AND POISONED WOUNDS.

PUNCTURED WOUNDS.

PUNCTURED wounds, made by narrow sharp-pointed instruments, vary greatly in extent, from the prick of a needle in the finger to a sword-thrust through the body. Not unfrequently punctured wounds are somewhat contused, being made by a triangular or wedge-like weapon, as a bayonet or lance-blade. Hence they partake of the general character of contused wounds, having a tendency to unite by granulation from the bottom, and to be accompanied by much inflammatory action. When deep, they are of a most dangerous character—wounding blood-vessels, traversing the great cavities, and injuring the contained viscera.

TREATMENT.—In the treatment of punctured wounds, the principal points are to arrest the hemorrhage, and to facilitate union.

The hemorrhage must be arrested by pressure properly applied by means of compresses or pads, so as to approximate the sides of the puncture, by the application of cold; or by cutting down on the injured vessel if it be a large one, and ligaturing it above and below the perforation in it.

In the majority of cases, unless the injury be a slight one, suppuration and union by the second intention will take place. This must be promoted by poulticing; and undue inflammation must be guarded against by local antiphlogistics. In many cases, union by adhesion is obtained; and in others that are allowed to suppurate, there can be little doubt that the same favourable termination might be secured if proper attention were paid to the injury. In former days, when duels with the small sword were of frequent occurrence, persons called “suckers,” who were often the drummers of a regiment, were employed to attend the wounded combatant. Their treatment, which was conducted with a certain degree of mystery, consisted in sucking the wound till all blood ceased to flow, and then applying a pellet of chewed paper or a piece of wet linen to the orifice; in this way it would appear that many sword thrusts traversing the limbs were healed in a few hours or days. The process of suction cleared the wound thoroughly of all blood, and, drawing the sides into close apposition, placed the parts in the most favourable condition possible for union by adhesion. This practice might, perhaps, in many cases be advantageously imitated in the present day by means of a cupping-glass and syringe.

Amongst the varieties of punctured wounds that are most commonly met with in ordinary practice, are those which are occasioned by needles penetrating into, and breaking off in the body. These accidents chiefly occur in the fingers and feet, and about the nates; and, though of a trivial character, are often extremely troublesome, both to surgeon and patient. When the surgeon is called shortly after the occurrence of the accident, he must

during the season of procreation, and their bites are most dangerous if inflicted through a vein or glandular part, or near the centre of the circulation, or about the neck and face. In tropical countries the bite of the rattle-snake, of the cobra di capello, the puff-adder, or the tobacco-pipe snake, is often fatal; and it occasionally happens in this country, that the surgeon has an opportunity of seeing wounds inflicted by these fearful reptiles in menageries. Thus, Sir E. Home has recorded a fatal case of rattle-snake bite occurring in this country. A similar instance has occurred at St. George's Hospital, and another in Paris, to showmen. The most remarkable case of this kind with which I am acquainted occurred some years ago at the University College Hospital, affording an opportunity, rare in this country, of witnessing the effects of the bite of a cobra di capello. The patient, a keeper at the Zoological Gardens, was bitten in the bridge of the nose, the poison-fang having apparently penetrated the angular vein. When brought to the hospital, about half an hour after the accident, he was apparently dying, being unable to speak, swallow, or support himself; the pupils were dilated, the face livid, the heart's action feeble, and he was scarcely conscious. After death, which took place in little more than an hour from the time of the infliction of the wound, the veins of the brain and the cerebral sinuses were found congested with blood, as were also the lungs to an immense extent, and the solid abdominal viscera. The right cavities of the heart were loaded with dark blood, the left being empty; indeed, the phenomena of asphyxia were strikingly marked. In this case, death would appear to have resulted from the poison paralysing the medulla oblongata, and those portions of the nervous system which are instrumental in carrying on respiration, at the same time that the blood was disorganised by the action of the virus.

Effects of Snake-Poison.—Snake-poison, when introduced into the system, may prove injurious or kill in two ways; either by its primary and direct depressing influence on the nervous system, somewhat resembling that produced by some narcotic poisons; or, secondarily and more remotely, by exciting severe diffuse inflammation of the cellular tissue of the limb or part.

The first mode of death occurs only when the poison is either very powerful, or the animal bitten small. Thus the poison of the tobacco-pipe snake is said to be so virulent, that it will kill a full-grown man in less than a quarter of an hour. The rattle-snake, and the cobra di capello, will kill a small animal in the course of a few seconds; and a man lately bitten by a rattle-snake in Paris, died in nine hours; the cobra bite just related was fatal in less than one hour.

In other cases again, the poison acts by exciting diffuse inflammation, suppuration, &c. of the cellular tissue. Thus, in the case which occurred in St. George's Hospital, the patient died on the eighteenth day after the bite of a rattle-snake, with large abscesses in the arm and in the axilla, and with sloughing of the cellular tissue of the limb.

The *Symptoms* occurring after a poisonous snake-bite consist in great depression and prostration of the system, a feeble and intermittent pulse, dilated pupils, usually slight delirium, speedy stupor, insensibility, and death. The part bitten swells and becomes livid in a few hours; and if the patient survive sufficiently long, diffuse inflammation and gangrene occur in its neighbourhood, involuntary evacuations take place; asthenic symptoms set in, which may eventually terminate fatally in the way that has already been mentioned, or end slowly, and after a lapse of time, in the recovery of the patient, whose health may long suffer seriously from the effects of the accident.

The period that intervenes between the bite and the occurrence of the disease is usually considerable. Meade has related the case of a lady who had the disease fifteen months after the bite. Elliotson says that the average time that elapses between the injury and the symptoms is from six weeks to three months. In the case of the Duke of Richmond, who was bitten by a tame fox, the disease did not develop itself until between six and seven weeks after the injury. Writers, however, in stating that six, seven, twelve, and even fifteen years have intervened between the infliction of the wound and the manifestation of the symptoms, have evidently committed an exaggeration or fallen into error, having very probably confounded with hydrophobia other nervous affections that closely resemble it.

Symptoms.—The wound has generally cicatrised long before any symptoms of hydrophobia declare themselves; and no peculiar appearance is presented by the scar. Shooting pains, twitching and itching sensations have, however, occasionally been experienced in the site of the wound before the supervention of the attack; and it is probable that in all cases some process analogous to a zymotic action takes place within it before the disease comes on. The precise nature of this, however, requires to be elucidated by further observation.

The general symptoms are usually ushered in by some antecedent phenomena for two or three days; according to Perry, for five or six. These introductory symptoms consist of giddiness, chills, and heats, and a general feeling of discomfort. The more *special* symptoms never manifest themselves until the disease becomes fairly established; they consist essentially in violent and repeated convulsive movements of a reflex character, induced by various external influences, whether acting on the surface of the body or on the fauces, or by mental impressions; and they speedily end in exhaustion and death. These special symptoms may be arranged under three heads: consisting of 1, Spasmodic Affection of the Muscles of Deglutition and Respiration; 2, Extreme Sensibility of the Surface and of the Senses; and 3, Excessive Mental Terror and Agitation.

1. In consequence of the *Spasmodic Affection of the Muscles of Deglutition*, the act of swallowing commonly excites convulsions; hence the patient experiences a horror of all liquids; and, in attempting to drink, gulps down the fluid with a strong mental effort. In some cases, solids give rise to the same difficulty in deglutition as liquids; but occasionally, though rarely, patients have been known to swallow perfectly well throughout the disease. This difficulty in swallowing is certainly owing to an excessive sensibility about the pharynx and throat, in consequence of which every effort at deglutition induces violent reflex convulsive movements.

A catch in the breathing, resembling what often occurs when a person goes into a cold bath, is met with as one of the earlier symptoms, taking place in the midst of conversation, and before the patient's mind is directed to the nature of the disease. This catch is due to the spasmodic descent of the diaphragm, and gives rise to severe pain at the pit of the stomach, or to a feeling of suffocation, and a return of the convulsions. In consequence of this spasm of the diaphragm, the patient makes from time to time a loud hiccuping noise, which has been likened to the bark of a dog.

2. An extreme degree of *Sensibility of the Surface, and of some of the Senses*, is characteristic of hydrophobia. The cutaneous nerves become so sensitive that a blast of cold air, the rustling of the bed-clothes, the slightest touch or movement on the skin, will bring on convulsions. The nerves of sense become equally excitable, so that a sudden flash of light before the eyes, as the reflection of the sun from a looking-glass, or a sudden noise, as the

clanging of a door, will produce the same effect. The noise produced by liquids being poured from one vessel to another is peculiarly distressing to the patient; and Dr. Elherton mentions a patient with hydrophobia being thrown into violent agitation by hearing the dresser, who sat up with him, make water.

The sufferings and convulsions that patients experience when they attempt to drink, appear to be owing to this excessive sensibility of the nerves of the mouth and pharynx, and the recollection of these sufferings makes them afraid to repeat the attempt; hence the fear of liquids from which the disease derives its name.

3. One of the earliest symptoms of hydrophobia, and one of the most persistent, is an extreme degree of *Mental Agitation and Terror*, a vague sense of dread and horror at the impending fate. Delusion sometimes occurs of a spectral character, the patient supposing himself to be surrounded by animals, by lateral forms, or by gaping, ghastly, and grinning countenances. The first symptom in the Duke of Richmond's case was, that he fancied some peculiar forms opposite his bed room window to be men looking in. These delusions may alternate with fits of delirium and frenzy. In these it is said that the patient barks like a dog, and endeavours to bite; but this is a peculiar error—the pretended bark is merely the catch in breathing, and the attempt to bite is nothing but movements of the tongue and mouth induced by the clamminess of the viscid andropy mucous saliva. Occasionally the symptoms subside completely before death; the sensibility of the surface disappearing, the mental agitation or delusion being removed, and deglutition and respiration being quietly performed. Thus Dr. Latham relates the case of a man labouring under this disease, who sat up quietly in bed and drank a pint of porter half an hour before he died.

Prognosis.—I am not acquainted with any authentic case of recovery from hydrophobia, after the disease has fairly set in. The disease may prove fatal in four and twenty hours, or life may be prolonged for six or seven days; death generally occurring from the second to the fourth day, and being apparently induced by exhaustion.

Pathology.—The appearances found after death throw no light whatever upon the disease, and indeed may often be supposed to be the effects rather than the causes of the spasmodic irritation. The tongue, the fauces, the throat, the glottis, and the larynx, the stomach and oesophagus, the brain, the medulla oblongata, and spinal cord, have all been found congested and inflamed; there is nothing, however, in the appearances presented by these parts that affords a clue to the true nature of this inscrutable and terrible disease. In fact, everything connected with hydrophobia is at present involved in complete obscurity. We neither know what occasions rabies in the dog, nor in what the change in his secretions consists, that enables him to transmit the disease to man. Equally obscure are the processes that are going on at the seat of the wound or in the constitution generally, during that lengthened period that intervenes between the infliction of the bite and the development of the disease; and lastly, pathological research has hitherto failed to throw the faintest glimmer of light on the nature of the changes which the nervous system undergoes, and which occasion the characteristic phenomena of the disease.

Treatment.—This must principally be of a preventive and palliative character. We cannot speak of curative treatment of hydrophobia; for, after the disease has once set in, the utmost that can be done will not accomplish more than to lessen the sufferings of the patient, and stay for a few hours the fatal termination.

When a person is bitten by a dog that is mad, or even by one that is supposed to be so, the surgeon should always adopt energetic means to save the patient from the invasion of a disease that is necessarily fatal. In having recourse to preventive treatment, it should be borne in mind that the larger proportion of persons actually bitten by rabid animals do not fall victims to hydrophobia; the probability of the occurrence of the disease depending partly upon the animal that bites, and partly upon whether the bite is inflicted on the naked or on the clothed part of the body. Thus Watson states, that of 114 persons bitten by mad wolves, 67 died of hydrophobia; whilst, according to Hunter and Vaughan, only one out of 20 or 30 bitten by mad dogs take the disease. This latter estimate may possibly be somewhat lower than the truth; yet the fact remains certain that wolf-bites are far more dangerous than dog-bites, and this is probably owing to the circumstance of wolves always flying at the face and naked parts. It is in consequence of this small proportion of persons taking the disease out of the total number bitten, that so many popular remedies and superstitions have obtained an unmerited reputation for preventing the disease. The only preventive means that can be trusted to by a surgeon, are *excision* and *caustic*.

Excision of the part bitten should be carefully and freely performed, no half measures being had recourse to. Hence it is better to remove too much of a comparatively unimportant tissue or part, than to allow the sufferer to run any risk of falling a victim to the fatal disease. In order to excise every part that has been touched by the tooth, the surgeon, after washing the wound and contiguous surface, should make a circle with ink, or tincture of iodine, completely round the injured part. He must then pass a probe to the bottom of the wound, and excise the whole by scooping out a conical piece of the tissues, taking care to go beyond the furthest limit to which the probe is passed. If there be any doubt of the whole of the injured parts having been removed, *potassa fusa* should be applied. If the lip be bitten through, a portion should be cut out, and the wound brought together, as in hare-lip operations; if it be a finger that is injured, amputation of it should be performed. In those cases in which the wound is so situated that excision cannot readily be performed, *potassa fusa*, or strong nitric acid, or nitrate of silver, as recommended by Mr. Youatt, should be freely applied to every corner of it.

If the bite have already cicatrised, the place should be excised at any time after the injury, provided the dog is known to have been, or to have become mad; for it is not improbable that the occurrence of some of the remoter cases of the disease is dependent upon, or connected with, some peculiar action set up in the wound, which might possibly be averted by the removal of the cicatrix.

I forbear to speak of any other means of preventive treatment, as I consider them utterly undeserving of confidence.

After the disease has once set in, nothing can be done but to *palliate symptoms* and to prolong life. Every possible remedy that the ingenuity of man could devise, from warm water to viper- and ticuna-poison, has been tried, and been found utterly useless. The only plan of treatment that holds out a hope of eventual success, and which, whether it succeed or not in curing the patient, at all events mitigates his sufferings, is that which has been recommended by Drs. Marshall Hall and Todd. It consists, in the first place, in removing all external irritation, whether mental or bodily; putting the patient in a darkened room, as much removed as possible from all noise and the intrusive curiosity of strangers, and surrounding his bed with gauze curtains or screens, so as to prevent the disturbing influence even

of a draught of cold air. Measures must then be adopted to lessen the instability of the spinal cord: this may be done most efficiently, as Dr. Hall suggests, by the application of ice in a piece of gut laid along the whole length of the spine. Lastly, the surgeon must bear in mind that he has to treat an exhausting disease, and that he must consequently support the patient by wine, beef-tea, and such nourishment as can be taken.

WOUNDS WITH INOCULATION OF DECOMPOSING ANIMAL MATTER.—The majority of wounds of this character are not dangerous. Every student of anatomy frequently punctures and cuts himself in dissecting, and it is but rarely that we see any ill consequences following these injuries. In some cases, however, the most serious results, terminating in permanently impaired health, or even in death, ensue. The result depends fully as much on the state of health of the person punctured, as on the condition of the body from which the puncture is received. If the health be broken by any cause, whether excess of study or dissipation, very serious effects may follow, which would not occur if the patient had the resisting power of a sound and strong constitution; hence it is of much importance to those engaged in the practical study of anatomy, not to allow the health to become impaired to too great an extent.

Causes.—The deleterious influence exercised by the dead body, human or brute, may be attributed to three different causes: 1, the mere ordinary irritation of the Wound; 2, Inoculation of Putrid Matter; or, 3, Introduction of a Specific Virus into the system. I think it is probable that each of these causes may exercise an influence, but that the worst effects of dissection wounds are dependent on the inoculation of a peculiar virus.

1. That ill effects sometimes result from the simple *Irritation of the Puncture*, is evident from the fact that we see mere scratches or punctures with splinters of wood, or other harmless substances, give rise to considerable local disturbance in certain states of the constitution; so also we find that those dissection-wounds which are ragged and torn, such as are made by species of bone or the teeth of a saw, are attended by peculiarly troublesome consequences.

2. *Putrescent Matters* must always be injurious when introduced into the economy; but at the same time it is a remarkable fact, that the worst dissection-wounds have been received before putrefaction had set in, and that they more commonly occur in *post mortem* inspections than in dissecting-room investigations.

3. That the worst forms of dissection-wounds are dependent upon a *Specific Virus*, is evident from the fact that it is especially after death from certain diseases, especially of an erysipelatous type, that these consequences ensue. Most danger is to be apprehended from punctures received from the bodies of those who die of erysipelas, phlebitis, and the diffuse forms of peritonitis following perturbation or the operation for hernia. That the poisonous influence from such bodies is transmissible to others by contact or infection, cannot be denied; and accoucheurs and operating surgeons should abstain as carefully as possible from performing *post mortem* examinations on patients dying from such diseases, lest the poisonous influence be carried to and excite similar morbid action in their own patients. The mere contact of such a body is occasionally dangerous. Thus, I have known a subject in the dissecting-room seriously infect in different ways six students who were working at it. Two had suppuration of the cellular tissue, under the pectorals and in the axilla; one was seized with a kind of maniacal delirium; a fourth had typhoid fever; and the remaining two were seriously, though not dangerously, indisposed.

Symptoms.—From what has been stated above, it would appear that there are two distinct kinds of mischief resulting from dissection-wounds.

The *miller form* is not of a specific character, but proceeds from the simple irritation of a scratch in a broken constitution, or from the inoculation of putrescent matter. In these cases the part punctured becomes painful, hot, and throbbing, in from twelve to twenty-four hours after the injury; the finger swells and inflames, the absorbents of the arm are perhaps affected, and the glands in the axilla become enlarged. There is general febrile disturbance of an inflammatory character, ushered in by rigors, and a feeling of depression; suppuration takes place about the puncture, and also, perhaps, in the inflamed glands, the case presenting the ordinary characters of whitlow with inflammation of the absorbents.

In the *more severe form* of dissection-wound, the patient is seized, about twelve or eighteen hours after the puncture, with rigors, anxiety of countenance, and depression of the nervous system: with a quick pulse, and with febrile reaction of an inflammatory character. On examining the finger, a pustule, or vesicle, with an indurated areola, will be observed in the situation of the puncture; from this a few red lines may be observed stretching up towards the arm-pit, with swelling and tension in this region. Diffuse inflammation of the cellular tissue of the limb sets in about the fifth or sixth day, extending up to the shoulder, and down the side of the chest to the flank. Abscesses form, often with much pain, in these situations; they are usually somewhat diffuse, the pus being mixed with shreds and sloughs. The general symptoms gradually assume an asthenic type, the tongue becomes brown, sordes accumulate about the lips and gums, low delirium sets in with a rapid, feeble pulse, and death occurs in from ten days to three weeks. When incisions are made into the brawny tissue, it is found infiltrated with sero-pus, and in a sloughy state. If the patient live, large circumscribed abscesses form under the pectorals, in the axilla, and above the clavicle, with much exhaustion and depression of the system, convalescence being tedious and prolonged, and the constitution being often shattered for life.

It is this form of the disease that resembles diffuse inflammation of the cellular tissue arising from other causes; and indeed there can be little doubt that it is a cellular erysipelas dependent on a toxic agency. That this form of dissection-wound is of a truly erysipelatous character, is evident from the fact that patients labouring under it will communicate fatal erysipelas to their nurses and attendants; as happened in the case of the late Mr. Potter, whose early death is so much to be lamented. It is also this kind of dissection-wound that is especially apt to occur after punctures, received from patients who have died of diffuse inflammation of the serous membranes.

Treatment.—On the receipt of a puncture in dissection, the best mode to prevent injurious consequences, is to tie a string tightly round the finger above the injury, thus causing the blood to flow, and perhaps to wash out the virus with it. The part should then be well washed in a stream of cold water at a tap, and sucked for some minutes; in this way any poisonous matter that has been introduced may usually be got rid of. I think that, in general, it is better not to apply caustics in these cases; they only irritate and inflame the finger, and can do but little good. If any caustic be employed, it should be a drop of nitric acid let fall into the wound. The nitrate of silver, which is commonly employed, can never do much good, as it does not penetrate to a sufficient depth to be of service. Dissectors should bear in mind that the state of the constitution exercises great influ-

ence upon the effects of the puncture ; and that, in proportion as the health is sound, there is less likelihood of any injurious consequences ensuing.

In the lighter forms of dissection-wound, attended by a moderate amount of inflammation, the part must be poulticed, leeches should be applied, and the arm put in a sling. If the absorbents become inflamed, chamomile and poppy fomentations must be diligently used, the early opening of abscesses has recourse to, and free incisions should be practised wherever there is much tension, even though matter have not already formed, with a view to prevent suppuration. The general treatment of clearing out the bowels with a free calomel purge, followed by moderate antiphlogistics, must be followed in the early stage ; but support will soon be required, and, if there be much constitutional irritation, opiates may advantageously be administered.

The treatment of the more severe forms of dissection-injury consists principally in fomentations, and in early and very free incisions into the finger or other parts that become tense and brawny. In the constitutional treatment our great reliance, after clearing out the intestinal canal by a free purge, such as five grains of calomel and fifteen grains of jalap, consists in the administration of bark, ammonia, camphor, wine, and brandy, with such nourishment as the patient can take ; the case being treated as one of the lowest forms of asthenic inflammation. If the patient survive, he must be sent as soon as possible into the country, and must devote some months, perhaps, to the re-establishment of his health. The part that has been punctured often continues irritable for a great length of time, even for many years, remaining red, inflamed, and desquamating, with perhaps the occasional formation of pustules on it. This condition is best remedied by the occasional application of nitrate of silver.

CHAPTER X.

EFFECTS OF HEAT AND COLD.

BURNS AND SCALDS.

A *Burn* is the result of the application of so great a degree of heat to the body as to produce either inflammation of the part to which it is applied, or charring and complete disorganisation of its tissues. A *Scald* is occasioned by the application of some hot fluid to the body, giving rise to the same destructive effects that are met with in burns, though differing from them in the appearances produced.

LOCAL EFFECTS.—Burns and scalds vary greatly in the degree of disorganisation of tissue to which they give rise ; this variation depending partly upon the intensity of the heat that is applied, and partly upon its duration. The sudden and brief application of flame to the surface produces but very slight disorganisation of the cuticle, with some inflammation of the skin. If the part be exposed for a longer time to the action of the flame, as when a woman's clothes take fire, the cutis itself may be disorganised ; and, if the heat be still more intense, as when molten metal falls upon the body, the soft parts may be deeply charred, or the whole thickness of a limb destroyed. So, also, the effects of scalds vary greatly, not only according to the temperature of the liquid, but according to its character ; the more oleaginous and thicker the fluid, the more severe usually will the scald be.

These various results of the application of heat to the surface have been

arranged by Dupuytren into six different degrees of burn. In the *first*, there is merely a scorch of the skin, slight redness with efflorescence of the cuticle, but no permanent injury. In the *second* degree, there is not only general redness of the part to which the heat has been applied, but vesicles form, either at once or in the course of a few hours, and sometimes attain a very considerable magnitude. In the *third* degree, the cutis itself is destroyed; yellowish-grey or brownish eschars form, and involve the whole thickness of the skin; and the surrounding integument is more or less reddened and vesicated, and the part extremely painful. If this amount of injury be the result of a scald, the eschara will be soft, pulpy, and of an ashy grey character. In the *fourth* degree, the whole thickness of the skin and part of the subcutaneous cellular tissue are destroyed; dry, yellowish black, insensible eschara being formed, with considerable inflammation around them, leaving on their separation deep and luxuriantly granulating ulcerated surfaces. In the *fifth* degree, the eschara extend more deeply, implicating the muscles, fasciæ, and soft structures. And, in the *sixth* degree, the whole thickness of the limb is completely destroyed and charred. This is the celebrated classification introduced by Dupuytren, and adopted by most writers on the subject as a practical exposition of the local effects of burns. These various degrees are usually found associated to a greater or less extent; indeed, in the more severe cases, the first three or four degrees are almost invariably met with together.

The primary *local effect*, then, of a burn, if superficial, is to excite inflammation of the skin; if more extensive, to destroy the vitality of more or less of the soft structures, and even the bones. When the cuticle is unbroken, the inflammation speedily subsides with some desquamation. When the soft parts are charred, they are detached by a process of ulceration, analogous to what happens in the separation of sloughs; and an ulcerated and suppurating surface is left, remarkable for the large size, the florid colour, the great vascularity, and the rapid growth of its granulations. The cicatrization of such an ulcer as this, though generally proceeding with great rapidity, has a constant tendency to be arrested by the exuberance of the granulations. The cicatrix that results is usually thin, and of a bluish-red colour, and is especially characterised by a great disposition to contract, becoming, after a time, puckered up, and much indurated. This process of contraction and hardening, which begins immediately on the completion of cicatrization, continues for many months, giving rise frequently to the most distressing deformities, and to the complete loss of motion and use in parts. These cicatrices are of a fibro-plastic and fatty character, and often extend deeply between, and mat together the muscles, vessels, and soft structures of a limb, of the face, or of the neck.

The *CONSTITUTIONAL EFFECTS* resulting from burn are of the most serious and important character; they are dependent not so much upon the depth of the injury as upon its situation, the extent of surface implicated, and the age of the patient. Thus a person may have his foot completely charred and burned off by a stream of molten iron running over it, with far less constitutional disturbance and danger than if the surface of the trunk and face be extensively scorched to the first and second degrees; burns about the trunk, the head, and the face, being far more likely to be attended by serious constitutional mischief than similar injuries of the extremities. In children, the system generally suffers more severely from burns than in adults.

The constitutional disturbance induced by burns, in whatever degree, may be divided into three stages: 1, Depression and Congestion; 2, Reaction and Inflammation; 3, Suppuration and Exhaustion.

1. The period of *Depression of the Nervous System and Congestion of Internal Organs*, occupies the first forty-eight hours; during which, death may occur before inflammatory action can come on. Immediately on the receipt of a severe burn the patient becomes cold and collapsed, and is seized with fits of shivering, which continue for a considerable time. He is violently suffering from the shock of the injury; the severity of the shivering is usually indicative of the extent of the constitutional disturbance induced by the burn, and is more prolonged in those injuries that occupy a great extent of surface, than in those which, being of more limited superficial extent, affect the tissues deeply. On the subsidence of the symptoms of depression, there is usually a period of quiescence before reaction comes on; and during this period the patient, especially if a child, not unfrequently dies comatose; death resulting from congestion of the brain and its membranes, with, perhaps, serous effusion into the ventricles or the arachnoid. Besides these lesions, the mucous membrane of the stomach and intestines, as well as the substance of the lungs, is usually found congested.

The pathological phenomena of this period are altogether of a congestive character. Of 15 cases in which the contents of the cranium were examined, congestion of the brain and its membranes, with serous effusion, was found in all; in 14 of these cases the thoracic viscera were examined, and found to be congested in 9, healthy in 5; and of 14 in which the abdominal organs were examined, congestion of the gastro-intestinal mucous membrane was found in 12 cases, and a healthy condition in 2 only.

2. The next period, that of *Reaction and Inflammation*, extends from the second day to the second week. In it irritative fever sets in early, with a degree of severity proportionate to the previous depression; and, as this stage advances, it is attended by special symptoms, dependent upon inflammatory affections, more especially of the abdominal and thoracic viscera. Death, which is more frequent during this stage than in the preceding one, is usually connected with some inflammatory condition of the gastro-intestinal mucous membrane, or of the peritoneum. The lungs also are frequently affected, showing marked evidence of pneumonia or bronchitis: but the cerebral lesions are not so common as in the first stage; though, when they occur, they present more unequivocal evidence of inflammatory action. Of 17 cases in which the contents of the cranium were examined during this period, there was congestion, with evidence of inflammation and effusion of serous fluid, usually of a bloody character, in 14; a healthy state in the remaining 3. Of 19 cases in which the lungs were examined, there was congestion of these organs, probably inflammatory in many instances, with serum or lymph in the pleura, and redness of the bronchial mucous membrane, in 10. The lungs were hepatized in 5, and healthy in 4. The abdominal organs were examined in 22 cases; of these there was congestion of the mucous membrane, with, in some cases, evidence of peritonitis, in 11; ulceration of the duodenum in 6; a healthy state in 5.

It is in this stage of burn, that the very remarkable and serious sequela, *perforating ulcer of the duodenum*, is especially apt to occur. Mr. Curling, who first attracted attention to it, explained its occurrence by the supposition that Brunner's glands endeavour by an increased action to compensate for the suppression of the exhalation of the skin consequent upon the burn; and that the irritation thus induced tends to their inflammation and ulceration. This ulceration may, as Mr. Curling remarks, by rapidly proceeding to perforation, expose the pancreas, open the branches of the hepatic artery, or, by making a communication with the serous cavity of

the abdomen, produce peritonitis, and thus cause death. It usually comes on about the tenth day after the occurrence of the injury; seldom earlier than this. The only exception with which I am acquainted was in the case of a child nine years of age, who died on the fourth day after the burn, in University College Hospital, and in whom an ulcer, of about the size of a shilling, with sharp cut margins, was found in the duodenum; the intestinal mucous membrane generally being inflamed. That these ulcers are not invariably fatal, is evident from a case mentioned by Mr. Curling, in which, on death occurring eight weeks after the injury from other causes, a recent cicatrix was found in the duodenum. These affections seldom occasion any very marked symptoms to indicate the nature of the mischief, the patient suddenly sinking. In some instances there is hemorrhage; though this is not an unequivocal sign, as I have several times seen it happen from simple inflammatory congestion of the intestinal mucous membrane. Pain in the right hypochondriac region, and perhaps vomiting, may also occur.

3. The period of *Suppuration and Exhaustion* continues from the second week to the close of the case. In it we frequently have symptoms of hectic, with much constitutional irritation from the long continuance of exhausting discharges. If death occur, it is most frequently induced by inflammation of the lungs or pleura; affections of the abdominal organs and brain being rare during this stage of the injury.

Of 7 cases in which the lungs were examined, they were found to be healthy in 1 only; being inflamed, hepatized with effusion in the pleura, in the remaining 6 cases. Of 7 cases in which the abdominal organs were examined, a healthy state was found in 4; inflammatory congestion in 2; and a cicatrised ulcer in the stomach in 1. In 5 of the cases the cerebral contents were examined, and were found healthy in 1 only; there being inflammatory congestion in the other 4.

PROGNOSIS.—The influence of extent, degree, and situation, on the prognosis of burns has already been stated. The most fatal element indeed of these injuries is *superficial extent*. Not only do the cutaneous nerves become greatly irritated, and the nervous system generally suffer severely, from the shock of an extensive burn; but, the cutaneous secretion being arrested over a large surface of the skin, congestion of the internal organs and of the mucous membrane must ensue; and hence death may happen directly from this cause, or from the supervention of inflammation in the already congested parts; more particularly in the early periods of life, when the balance of the circulation is readily disturbed. The *degree* of burn influences the prognosis unfavourably rather so far as the part itself is concerned, than as the general system is affected. The most fatal *period* in cases of burn is the first week after the accident. I find that, in 50 cases of death from these accidents, 33 proved fatal before the eighth day; 27 of these dying before the fourth day. Of the remaining 17 cases, 8 died in the second week, 2 in the third, 2 in the fourth, 4 in the fifth, and 1 in the sixth.

MODE OF DEATH FROM BURN.—When in an ordinary conflagration a person is "burnt to death," the fatal event is occasioned not by the charring, roasting, or actual burning of the body, but by the induction of asphyxia. Life is unmercifully extinguished by suffocation in the smoke, gases, and noxious vapours resulting from the fire, before the body itself is consumed.

When a person is severely and extensively burnt, and dies in the course of a few hours, or a day or two, death arises usually from the shock of the injury, which is of a most severe and continuous character. Dupuytren was of opinion that during this stage the sufferer died from the excessive pain,

and stated that "too great a loss of sensibility might kill as well as too great loss of blood." Whether this is so or not, it is perhaps difficult to say, but the fact remains certain that, in individuals who die during this stage, the brain and its membranes will invariably be found congested, usually with more or less effusion of serous fluid into the ventricles or the arachnoid. This I have invariably found in every case that I have examined. In one half of the cases I have found congestion of the thoracic organs, and in the majority congestion of the abdominal organs, more especially of the mucous membrane of the stomach and ileum. Death during the second stage is usually dependent upon internal inflammation, more particularly of the gastro-intestinal mucous membrane and lungs, and less frequently of the brain and its membranes. If the patient survive into the period of suppuration, and then succumb, he will usually die from exhaustion hastened or accompanied by inflammation of the lungs or pleura.

TREATMENT.—The treatment of burns must have reference to the constitutional condition, as well as to the local injury. A vast variety of local applications have been recommended by different surgeons, such as flour, starch, cotton-wadding, treacle, white paint, gum, solution of India-rubber, &c., the principle is, however, the same, viz., the protection of the burnt surface from the air. I shall here content myself with describing the method that is usually followed with much success at the University College Hospital.

The *Constitutional Treatment* is of the utmost consequence. We have seen how death arises at various periods after these accidents from different causes, and we must modify our treatment accordingly. The first thing to be done after the infliction of a severe burn is to bring about reaction; the patient is trembling in a state of extreme depression, suffering great pain, is cold and shivering, and may sink from the shock unless properly supported. A full dose, varied according to the age, of liquor opii should be given at once in some warm brandy and water, and repeated, if necessary, in the course of an hour or two.

When the stage of reaction has fairly set in, the patient's secretions should be kept free by the administration of an occasional mild purgative and saline. Should any inflammatory symptoms about the head, chest, or abdomen manifest themselves, it will be necessary to have recourse to treatment proportionate to their nature. I have certainly seen patients saved under these circumstances by the employment of blood-letting and the application of leeches. But, in the vast majority of instances, the visceral complications are of a low and congestive character. In such cases our great reliance must be on stimulants. Ammonia and bark, brandy and wine, require to be freely given, with a sufficiency of nourishment; and the irritability of the nervous system must be soothed by the frequent administration of full doses of opium. At a later period, when the strength has become weakened by the profuseness of the discharges, this tonic and stimulating plan must be actively continued.

Local Treatment.—The burnt clothes having been removed, the patient should be laid upon a blanket, and, whatever the degree of the burn, be well covered with the finest wheaten flour by means of an ordinary dredger. The flour should be laid on thickly, but uniformly and gradually; it forms a soft and soothing application to the surface. If the cuticle have been abraded or vesicated, the flour will form a thick crust, by admixture with the serum discharged from the broken surface. If the skin be charred, the discharge, which will be speedily set up around the eschar, will make the flour adhere to the part, forming, as it were, a coating impervious to the

air. The crusts thus formed should not be disturbed until they become loosened by the influence of the discharges, when they should be removed, and the ulcerated surface that is exposed should be dressed with water-dressing, red-wash, or lead ointment, according to the amount of irritation existing, the suppurating sore indeed being managed on ordinary principles. In some cases, lint dipped in the "*Carron oil*," composed of equal parts of linseed-oil and lime-water, to which a small quantity of spirits of turpentine might be added, has appeared to agree better than anything else; and in others cotton-wadding answers admirably. Whatever local application be adopted, I hold it to be of the utmost importance in the early stages of the burn to change the dressings as seldom as possible, not, indeed, until they have been loosened, or rendered offensive by imbibition of the discharges. Every fresh dressing causes the patient very severe pain, produces depression, and certainly retards materially the progress of the case.

Prevention and Removal of Contraction.—As cicatrisation advances, much attention should be paid to repressing the exuberant granulations by the free use of the nitrate of silver; and the position of the part must be carefully attended to, so as to counteract, if possible, the after-contraction that ensues. With this view, the part must be properly fixed by means of bandages, splints, and mechanical contrivances, specially adapted to counteract the tendency to contraction of the cicatrix. This is especially necessary in burns about the neck, when there is a tendency for the chin to be drawn down on to the sternum, and great deformity to be thus occasioned; and in burns at the inside of limbs or the flexures of joints, more especially the elbow, where after-contraction is very apt to ensue. The contraction of cicatrices in bad burns of the hands will especially require attention, as in these cases the fingers may be drawn into and fixed upon the palm of the hand, or may meet and become webbed, or may even, as in Fig. 62, be



Fig 62.—Deformity of Hand from Cicatrix of a Burn.

dislocated backwards and fixed immovably against the dorsum. In such cases, I have advantageously employed the elastic traction of India-rubber bands to counteract the tendency to contraction of the scar.

Operations for the Removal of the Effects of Contraction, consequent upon burns, are occa-

sionally required; and, if judiciously planned and executed, may do much to remedy the patient's condition. The operations that are practised with this view are of two kinds. 1. Simple division of the faulty and contracted cicatrix. 2. The transplantation of a flap of adjacent healthy skin into the gap left after the division of the cicatrix.

1. In the first operation, that of simply *Dividing the Cicatrix*, three points require special attention. 1. That the division extend completely through the cicatrix from side to side into the adjacent healthy skin; 2. That the incision be carried through the whole depth and thickness of the cicatrix into the healthy cellulo-adipose layer which will be found developed beneath it, and may always be recognised by its yellow colour; 3. That all contractile bands lying in this layer be fairly divided. The great obstacle to the success of this operation, however, consists in the fact that the new granulations, which spring up after the division of the contracted cicatrix, are in their turn liable to take on contractile action. After the division of the cicatrix, also, it may be found that the subjacent structures have been so

the angle of the mouth (A). The two flaps thus marked out are freely and deeply dissected up. The alveolar border of the middle portion is then



Fig. 65.—Incisions in Teale's Operation for Cicatricial Deformity of the Lower Lip

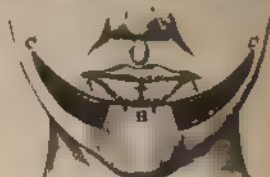


Fig. 66.—Teale's Operation, the Flaps in Place

freshened. The lateral flaps (Fig. 66, CA) are now raised, united by twisted sutures in the mesial line, and supported as on a base by the middle flap, to which they are also attached by a few points of suture, leaving a triangular even surface (C C) to granulate. In addition to the division of the cicatrix, Mr James, of Exeter, has in these cases very successfully employed a screw-collar, by which the chin can be loosened from the sternum, and gradual extension of the cicatrix effected.

Warty Cicatrices.—The cicatrices of burns, especially about the neck and chest, occasionally assume after a time a projecting, red, and glazed appearance, looking as if they were composed of a mass of fungating granulations smoothed down and lightly skinned over. This condition, which may be looked on as a substantive disease, and resembles Cheloid in appearance, has chiefly been met with in children; but I have several times seen it in the adult, in women who had been badly burnt by their dresses taking fire. In these cases I observed what I have noted in other similar instances in children; that the warty cicatrices were the seat of the most intolerable itching, which no external application seemed to relieve. I have, however, seen the pruritus mitigated by the administration of large doses of liquor potassæ. If small and narrow, these cicatrices may be dissected out; if large, they would not admit of removal without risk of considerable hemorrhage, as their structure, though fibroid, is very vascular.

The cause of this peculiar outgrowth of dense cicatricial tissue is altogether unknown. It may in some cases, perhaps, be owing to want of care in checking the luxuriance of the granulations; but in other cases it occurs though every attention is paid to the healing of the wound.

Amputation may be required if the burn have destroyed the whole thickness of a limb; the part charred should then be removed at once, at the most convenient point above the seat of injury. This operation may also be required at a later period, if, on the separation of the eschars, it be found that a large joint has been opened, and is suppurating; or if the disorganization of the limb be so great as to exhaust the powers of the patient in the efforts at repair. Great caution, however, should be employed in determining on the propriety of amputating when the burn has extended, though in a minor degree, to other parts of the body, lest the powers of the patient be insufficient for the double call that will thus be made upon them.

FROST-BITE.

When the body has been exposed to severe or long-continued cold, we find, as in the case of burns, that local and constitutional effects are produced.

LOCAL INFLUENCE OF COLD.—This is chiefly manifested on the extremities of the body, as the nose, ears, chin, hands, and feet, where the circulation is

CHAPTER XI.

INJURIES OF BLOOD-VESSELS.

INJURIES OF VEINS.

Veins are very commonly wounded suicidally, accidentally, or in surgical operations; but unless they be deeply seated, their injuries are seldom attended by any serious consequences. Occasionally subcutaneous rupture or laceration of a vein takes place from a blow or strain. In such cases extensive extravasation of blood will occur, which, however, usually undergoes absorption in a few weeks; but it may suppurate, or take on itself the changes described at page 106. This accident is most commonly seen in the saphena vein.

There are three sources of danger in open wounds of veins: 1, Loss of Blood; 2, Diffuse Inflammation of the Vessel; 3, Entrance of Air into the Circulation.

1. A vein is known to be wounded, when dark blood flows in a rapid and uniform stream from the seat of injury. If the vessel wounded be one of considerable magnitude, or in close proximity to the centre of the circulation, the flow of blood may be rapidly fatal, more especially if its escape is favoured by the dependent position of the part.

The *Hæmorrhage* from a wounded vein may, if the vessel be superficial, be arrested by position, and the pressure of a compress, with a few turns of a roller. If the vein be one of considerable size, as the internal jugular; or if it be so situated that pressure cannot be brought to bear on it, it may require the application of a ligature; but this should, if possible, always be avoided, inasmuch as it is apt to occasion dangerous inflammation of the vessel.

The wound in a vein is healed by slight inflammation taking place about the lips of the incision, and giving rise to the formation of a distinct cicatrix.

2. In some cases, from the irritation of the simple wound, and in others from the application of the ligature, a *Diffuse form of Inflammation of the Vein* takes place, which usually proves fatal. This variety of phlebitis will be described when we come to speak of the different kinds of venous inflammation.

3. The *Entrance of Air into Veins*, being a subject of much importance, will be discussed in a subsequent chapter.

INJURIES OF ARTERIES.

Arteries may be bruised, torn, punctured, or cut.

CONTUSION.—A slight bruise of an artery is not attended by any bad consequences; but, if the contusion be severe, obliteration of the vessel by adhesive inflammation may ensue some days after the accident. Thus, a patient was admitted into University College Hospital under Mr. Quain, with a contused wound in the axilla, received in falling upon some iron railings; no change took place in the circulation of the arm for two days, when pulsation in the radial artery ceased, the injured vessel having evidently become obliterated by adhesive inflammation.

RUPTURE AND LACERATION.—An artery may be torn either partially or completely across. When *Partial Rupture* occurs, the internal and middle coats only give way, the toughness of the external coat preventing its

and narrow aperture with the surface, little, if any, external hemorrhage takes place, but extravasation of blood occurs. The extravasation may either be poured into one of the serous cavities, or it may be diffused in the cellular tissue of the limb or part, infiltrating it deeply and extensively : and perhaps by its pressure giving rise ultimately to gangrene ; or it may be effused in a more circumscribed manner, giving rise to one or other of the forms of traumatic aneurism.

HEMORRHAGE FROM WOUNDED VESSELS.

LOCAL SIGNS.—The characters of the bleeding or hemorrhage differ according to the nature of the vessel from which the blood escapes. When a *Vein* is wounded, the blood that is poured out is of a dark colour, and flows in a uniform stream ; the force with which this is projected depending on the conditions in which the wounded vein is placed. If there be any pressure between the wound and the heart, as of a ligature upon the vessel ; if the position of the part be such as to favour the gravitation of the blood towards the wound ; or if the muscles of the limb be made to contract, the force of the flow of blood will be increased.

When an *Artery* is wounded, the blood that escapes is of a bright vermilion or scarlet colour. It flows by jets, synchronous with the contractions of the left ventricle ; and between each jet the flow does not cease, but the stream becomes continuous. In the great majority of cases the jet comes only from the proximal aperture, dark blood issuing from the distal opening in a continuous and trickling stream ; but in some situations a jet of blood of an arterial character may issue from the distal as well as from the proximal end of the cut vessel, as in wounds of the palmar and plantar arches, or of the arteries of the forearm. As the blood flows, the jet lessens in height, in consequence of the weakening of the heart's action. The height and force of the jet in all cases depend greatly on the size of the vessel ; thus the jet from the femoral artery is stronger than that from a muscular branch of the thigh. When a small arterial branch is wounded near its origin from the main trunk, the jet will always be forcible and free ; so also the proximity to the centre of the circulation will influence materially the force with which the blood is propelled from the wound in the vessel.

Extravasation.—When the blood is not poured out on the surface, but escapes from a wounded vessel into the cellular tissue of a part, the substance of organs, or internal cavities, it is termed an *Extravasation*. In these cases there are not the ordinary local signs of an external hemorrhage ; but other local phenomena, such as swelling, dulness on percussion, displacement of organs or parts, discoloration of the skin and subjacent cellular tissue, indicate that blood is being poured out subcutaneously ; and we judge of the quantity of the blood that has so escaped, not only by the extent of these local phenomena, but by the general effect produced upon the system by its loss.

CONSTITUTIONAL EFFECTS OF HEMORRHAGE.—These depend upon the quantity of blood lost, on the rapidity with which it is poured out, on the state of the patient's constitution, and on the vessel which furnishes the bleeding.

When a large quantity of blood is suddenly lost, as when a main artery is cut across or an aneurism bursts, the patient may die forthwith ; falling down in a state of syncope, with a pale cold surface, lividity about the lips and eyes, and a few gasps, sighs, great restlessness, and convulsive movements of the limbs before he expires. If the quantity lost be not so great as to produce death, but is yet very considerable, the patient becomes faint and sick, with coldness and pallor of the surface, great restlessness and

agitation, thirst, noises in the ears, and failure or complete loss of sight. If the quantity lost, though considerable, be not so great as this, or be spread over a greater interval of time, so that the patient is enabled to rally between the recurrences of the hemorrhage, a state of anemia will be induced, characterised by pallor of the skin and of the mucous membranes, palpitatio of the heart, rushing noises in the head, amaurosis, a tendency to syncope when in the erect position, oedema of the extremities, and general debility of the system.

After excessive loss of blood the patient may gradually rally, and, as the vital fluid is reproduced in his system, he may recover without any bad effects; or he may fall into a state of anemia, which may perhaps never be completely recovered from, and may be associated with various forms of local debility and disturbance of functions. After very abundant loss of blood, "hemorrhagic fever" is apt to set in, characterised by a tendency to reaction in the system, with extreme irritability of the heart and arteries. It is irritative fever conjoined with anemia. There is but a small quantity of blood in the system, and the heart and arteries make violent efforts to drive it forward. This condition is marked by the symptoms of extreme loss of blood, alternating with periods of intermittent reaction; the pulse becomes much hurried, fluttering, jerking, and irregular in force and frequency; there is slight flushing of the face and brilliancy of the eyes, rapidly passing again into pallor and syncope; and if the hemorrhage eventually prove fatal, delirium and convulsions, with excessive restlessness, usually precede death. The body of a person who has died from the effects of hemorrhage presents a peculiarly blanched, semi-transparent, waxen look; the lips, alae of the nose, and finger-nails, have a somewhat livid appearance, contrasting strongly with the clear, yellowish-white hue of the general surface. Arterial is more dangerous than venous hemorrhage. The same quantity of blood poured out from a wounded artery will produce a greater effect on the system than an equal loss of blood from a divided vein. Children bear the loss of blood badly—a very small quantity may induce fatal syncope in infants.

TREATMENT.—The *General Treatment* of hemorrhage is sufficiently simple. After the flow of blood has been arrested by proper local means, such as will hereafter be described, the effects of its loss are usually speedily recovered from by rest and good nourishment. In some cases, however, the nutritive process becomes permanently impaired, and a state of chronic anemia is induced, which, notwithstanding the administration of chalybeate preparations, may continue through life, and terminate in cachexia, phthisis, or carcinoma.

When the loss of blood is considerable, and is attended by symptoms of much prostration, it may be necessary to have recourse to immediate measures in order to prevent the syncope from being fatal. With this view the patient should be laid recumbent, with the head low; and pressure may be exerted upon the abdominal aorta or the main arteries of the limbs, so as to confine the blood as much as possible to the nervous and circulatory system. If death appear imminent from the effects of the hemorrhage, as happens in some cases of flooding, transfusion of blood may be had recourse to, the influence of which, in restoring the failing powers of the heart and vascular system, is immediate and most striking, and has been unquestionably determined by the observations of Dr. Blundell and other obstetricians.

The operation of Transfusion is one of some delicacy, and requires care, as mischief has occasionally been occasioned by the injection of air together with the transfused blood—an accident that would probably prove fatal to the patient. If

the proper transfusing apparatus, such as Higginson's or Blundell's, by which the blood may be injected without the risk of admixture of air, and of a proper temperature, be not at hand, an ordinary hydrocele-syringe capable of holding about six ounces, and fitted with stop-cock and cannula, may be used. An opening of sufficient size having been made in one of the larger veins at the bend of the arm or about the instep, and the cannula having been introduced for about an inch, the syringe, previously warmed, should be filled, and about twelve ounces of freshly drawn human blood slowly but steadily injected, the limb being placed in such a position as to favour its transmission to the heart. In performing this operation, the principal points to be attended to are; the proper introduction of the cannula into the vein with as little injury as possible to its coats; the perfect freedom of the whole apparatus from bubbles of air; and the steady but rapid performance of the operation, so as to avoid coagulation and deterioration of the blood. If transfusion be determined on, it should not be delayed until the last moment, when the agony of death has already commenced; as then the actions of the nervous and circulatory systems may be so impaired that the patient is no longer recoverable, or, if temporarily so, will speedily relapse into a state of fatal disease.

The *Local Treatment* of hemorrhage will be fully described in the next chapter.

CHAPTER XII.

ARREST OF ARTERIAL HEMORRHAGE.

THE arrest of arterial hemorrhage is perhaps the most important topic that can engage the surgeon's attention, as on the safe accomplishment of this the success of every operation is necessarily dependent. In studying this subject we must first investigate the Means that are adopted by Nature for the Suppression of the Hemorrhage; and, secondly, the imitation of these by Surgical Art.

NATURAL ARREST OF HEMORRHAGE.

The history of the investigations into the means adopted by nature for the arrest of hemorrhage is full of interest to the surgeon, and is excellently given in Jones's work on Hemorrhage. No subject in surgery affords a stronger evidence of the advantage of the application of "*Experimental Pathology*" to practice, than this, as our knowledge of it has been wholly gained by experiments on the lower animals.

Petit, who published several memoirs on this subject in 1731 and following years, states that hemorrhage is arrested by the formation of two clots—one outside the vessel, which he calls the "*Couvercle*;" the other inside, the "*Bouchon*;"—the first being formed by the last drops of blood that issue, the second by the few drops that are retained. These clots by their adhesion stop the bleeding. When a ligature is applied, a similar clot forms above and below it. He recommends compression, and the support of the clot.

Morand, in 1736, added much of interest. He admitted the formation of coagula, but insisted on the change in the artery itself; which, he showed, became corrugated, contracted, and retracted. Morand entertained erroneous views as to the structure and functions of arteries, but he established the *great fact that changes occur in the artery itself.*

interior of which is left rough and uneven. Through this uneven channel the blood is projected, either flowing freely externally or being extravasated into the neighbouring cellular tissue, according to the direction and state of the wound. As the blood flows over the roughened surface of the sheath, it becomes entangled in the fibres, and tends to coagulate upon them: this tendency to coagulation is favoured by the increased plasticity of the blood as it flows, and by the diminution of the propulsive force with which it is carried on. By the conjoined operation of these causes a coagulum is formed, which, though lying within the sheath, is outside to, and extends beyond the artery; and is hence termed the *external coagulum*. It is usually of a somewhat cylindrical shape, and often looks like a continuation of the vessel, being at first perforated by a hollow track, through which the stream of blood continues to flow. As it increases, the hollow becomes closed by the concentric deposit of coagulum. The hollow track leading from the surface of the coagulum to the wound in the artery, has been especially described and dwelt upon by Amussat. This coagulum acts mechanically by blocking up the end of the artery, and also by compressing the vessel within the sheath; thus constituting the first barrier to the hemorrhage. The formation of the external coagulum is thus in a great measure dependent on the retraction of the artery within its sheath.

The next changes that take place in the artery, and, indeed, that are to a certain extent simultaneous with those that have just been described, are, its *Contraction* and the formation of the *Internal Coagulum*.

The *Contraction* of the cut artery commences immediately after its division, and may of itself be sufficient to close the smaller arteriae. Thus, during an operation, we may often see an artery which, when first cut, jetted a stream of blood as large as a straw, gradually contract in size until it cease to bleed, owing simply to this contraction. In a larger artery this process is not sufficient to close completely the vessel, but merely gives it cut end a conical shape, diminishing greatly the aperture, and converting it into a kind of pin-hole at the end of the artery.

In proportion as the open end of the artery is obstructed by the external coagulum and contracts in diameter, the blood is propelled with more and more difficulty through it, until at last it escapes in but a small and feeble stream, or even becomes completely at rest, allowing its fibrine to be deposited in a slender coagulum, which plays a more important part in the permanent than in the temporary arrest of the bleeding. To the formation of this *Internal Coagulum* the contraction of the vessel is subservient. This coagulum is slender and of a conical shape, the base being attached to the margins of the aperture in the vessel, and the apex extending upwards. It has no point of attachment except by its base, the apex and sides being perfectly free; it is at first composed entirely of coagulum of a firm fibrinous character, no exudative matter entering into its composition at this period, though after-changes of an important character occur within it. The importance of the internal coagulum, as a temporary means of arresting hemorrhage, though great, has, I think, been overestimated. It is not formed at all in certain states of the blood, when that fluid is devoid of plasticity; and in some cases the proximity of a collateral branch to the cut end of the vessel appears, by preventing the stasis of the blood within it, to interfere with coagulation. Even when it is formed, it is of but little service, so far as the primary arrest of the hemorrhage is concerned, not being deposited until after the flow of blood has been checked by other means, such as the deposit of the external coagulum and the contraction of the vessel. After it is formed, it is useful in acting as a *dampener*, and in

formation of its cut extremity, up to the first collateral branch, into a dense fibro-cellular cord. This is effected by the plastic effusion inside and outside the artery, with the cut and contracted vessel in the centre, developing into fibro-cellular tissue.

ARREST OF HEMORRHAGE FROM A PUNCTURED OR PARTIALLY DIVIDED ARTERY is effected in a somewhat different manner from what has been just now described; the difference consisting in the changes that go on in the neighbourhood of the wound. If the wound in the soft parts covering the artery be of small size and oblique in direction, so that the blood does not escape with too great facility, it will be found that the temporary arrest of the hemorrhage takes place by an extravasation of blood occurring between the artery and its sheath, by which the vessel is not only compressed, but the relations between the wound and the aperture in the sheath are altered. This stratum of coagulated blood extends for some distance within the sheath, above and below the wound, opposite to which it is thicker than elsewhere. Coagulum may likewise be formed in the tissues of the part outside the sheath, by which the vessel is still further compressed, and the tendency to the escape of blood proportionately lessened.

The permanent closure of the puncture is effected by adhesive inflammation. Lymph may be effused in such a way as to be sufficient merely to plug the wound in the coats, or else it may be in sufficient quantity to obliterate the whole of the interior of the artery, producing complete occlusion of it. In order that the wound in the artery should unite without obliterating the cavity of the vessel, but simply by the formation of a cicatrix in the coats, it is necessary that it be below a certain size: but this size will vary according to its direction. If the wound be longitudinal or slightly oblique, it will be more likely to unite in this way than if transverse. Mr. Guthrie states that, in an artery of the size of the temporal, a small longitudinal wound may sometimes heal without obliteration of the vessel, though this very rarely happens in arteries of larger size. If a vessel of the size of the femoral be opened to the extent of one-fourth of its circumference, there is no proof that the wound can heal without obliteration of the cavity of the artery; but when the longitudinal wound is very small in a large artery, little more than a puncture, closure may possibly take place simply by its cicatrization. The plastic matter forming the cicatrix is thrown out by the external coat of the artery. The internal and middle coats do not unite strongly, the aperture in them being merely filled up by a plug of lymph; hence the artery always continues weak at this point, and may eventually become aneurismal.

If an artery of the second or third magnitude, as the axillary or femoral, be divided to one-fourth or more of its circumference, either fatal hemorrhage or the formation of a traumatic aneurism will usually take place. In those comparatively rare cases, however, in which the hemorrhage is arrested without these consequences ensuing, it will be found that it is so, by the vessel becoming obliterated by a plug of lymph, which is poured out at the wounded part and gradually encroaches on the cavity of the artery, until complete obliteration is produced, and the vessel at the seat of obstruction becomes converted into a fibro-cellular cord.

SURGICAL TREATMENT OF ARTERIAL HEMORRHAGE.

The object of the surgeon, in any means that he adopts for the suppression of arterial hemorrhage, is to imitate, hasten, or assist the natural processes, or to excite analogous ones. All his means act by increasing the retraction and contraction of the arterial coats, by forming an

artificial coagulum, or by exciting adhesive inflammation in and around the vessel.

The danger from arterial hemorrhage, and the measures that must be adopted to meet it, vary according to the size of the vessel. Under all circumstances the surgeon should bear in mind the excellent advice given by Mr. Guthrie, never to fear bleeding from any artery on which he can lay his finger: the pressure of this readily controlling the bleeding from the largest vessels, provided it can be fairly applied, or the cut end of the artery seized between the finger and thumb. Thus, in amputation at the hip and shoulder-joints, the assistant readily controls the rush of blood from the femoral and axillary arteries by grasping them between his fingers. Above all, the surgeon should never dread hemorrhage, nor lose his presence of mind when it occurs. If recourse be had to effectual means for its suppression, it can always be at least temporarily arrested. And on no account should any surgeon have recourse to inefficient means to stop it, and endeavour by covering up the wound with rags, handkerchiefs, &c., to prevent the escape of blood. These means only hide the loss that is going on, and, by increasing the warmth of the parts, prevent the contraction of the vessels, and favour the continuance of the bleeding. Under all circumstances, therefore, bleeding wounds should be opened up, the coagula gently removed from their surface, by means of a piece of soft sponge or a stream of cold water, and the part well cleaned. In this way "you look your enemy in the face," and can adopt efficient means for the permanent arrest of the hemorrhage.

The flow of blood through a limb may be controlled for a temporary purpose, assisting an operation, by the compression of the main artery by the hands of an assistant. This may be done in the lower extremity by pressing the femoral artery against the brim of the pubic bone, and in the upper extremity by compressing the subclavian against the first rib, or the brachial against the shaft of the humerus. The pressure should be made by grasping the limb with one hand in such a way that the index and middle fingers bear upon the artery, and press it directly against the subjacent bone. If the limb is large, or if long-continued pressure be required, the same fingers of the other hand should be firmly applied upon those that are already compressing the vessel. In some cases, especially when the subclavian or external iliac requires to be compressed, the handle of a large key, or the end of a thick wax, covered with leather, will be found the most convenient instrument for applying the pressure.

In particular and exceptional instances, where the artery has become unusually deeply seated—as, for instance, where the clavicle has been pushed up from its articulation by an aneurismal tumour—and when ordinary means for effecting a secure compression of the vessel, a very effectual mode of arresting the flow of blood through it has been adopted by Syme. This consists in making an incision through the skin and superficial fascia over the artery, so that the fingers of the assistant may be brought to bear almost directly upon the vessel, which may thus be securely and efficiently compressed.

In most cases, however, in which temporary compression of the artery is required, the *Tourniquet* should be employed. It is far safer to trust to this instrument, than to the hands of an assistant, however steady and strong. The *Tourniquet* is applied with a sufficient degree of tightness, the flow of blood through the limb may be completely arrested. Thus can the hemorrhage by the compression of the main trunk alone, the collateral branches supplying vessels conveying blood into the limb independently of

it. Then again, if the operation be unexpectedly protracted from any cause, the fingers of an assistant may tire or stiffen; and, the steadiness of their pressure becoming relaxed, hemorrhage may ensue. For these reasons, surgeons almost invariably employ the tourniquet in amputations; and even the late Mr. Liston, who at one period of his career discarded this instrument, commonly employed it during the latter years of his life. There are three tourniquets used by surgeons. Petit's consists of two plates attached to a band, which is buckled round the limb over a pad that has previously been applied above the artery to be compressed (Fig. 21). By the action of a quick screw the plates can be separated, the band tightened, and the pad forced against the artery. In applying the tourniquet, care should be taken not to screw it up until the very moment when the compression is required, and then to do so quickly and with considerable force, lest venous congestion of the limb take place, by the veins being compressed before the circulation in the arteries is arrested. The horse-shoe and Signoroni's and Skey's tourniquets, appear to me to have no advantage over the one described; and they possess the disadvantage of not compressing the collateral vessels, and consequently of commanding the circulation in a less perfect manner than the ordinary instrument.

The different means that may be employed for the *permanent* arrest of hemorrhage are, 1, the Application of Cold; 2, Styptics; 3, Cauterisation with the Hot Iron; 4, Pressure; 5, Torsion; 6, Acupressure; and 7, Ligature.

1. APPLICATION OF COLD is sufficient to arrest the general oozing of arterial blood which is always observed on a cut surface. The mere exposure of a wound, which has bled freely so long as it has been covered up by pledgets and bandages, to the cold air, is often sufficient. When this does not succeed, the application of a piece of lint, soaked in cold water, will usually arrest the flow of blood. When it is necessary to do this speedily, as in some operations about the air-passages, a small stream of cold water may be allowed to drip into the wound, and thus cause rapid contraction of the vessels, and consequent cessation of bleeding. In cases of bleeding into some of the hollow cavities of the body, as the rectum, vagina, or mouth, the application of ice is advantageous. Its use should not, however, be too long continued, lest sloughing occur. Indeed, if cold do not speedily, almost at once, arrest the bleeding by constricting the vessels, it is better to have recourse to other and more efficient means.

2. STYPTICS influence powerfully the contraction of the vessels, and, by increasing the rapidity of formation and the firmness of the coagulum, tend to arrest the hemorrhage; they are principally used in oozing from spongy parts, or in bleeding from cavities or organs, to which other applications cannot readily be made. The great objection to their employment in some wounds consists in their tendency to modify the character of the surface, and to prevent union by the first intention. The most useful styptics are the solution of perchloride of iron, spirits of turpentine, gallic acid, and matioc; the application of alum, or touching a bleeding part with a pointed stick of the nitrate of silver, is also serviceable. Of all these, the solution of the perchloride of iron when injected into or applied upon a part, acts as the readiest and most efficient hemostatic, coagulating the blood with remarkable rapidity, and into a very firm clot.

3. CAUTERISATION by means of the red-hot iron was almost the only mode of arresting arterial hemorrhage that was known to the ancients. It is now comparatively seldom had recourse to, but yet in many cases it is of the most unquestionable utility, and superior to any other means that we possess.

more particularly in those cases in which the hemorrhage proceeds from a soft and porous part that will not hold a ligature, or from the surface of which many points appear to be bleeding at the same time. A somewhat conical iron of sufficient size should be used, and the hemorrhage will often be staid more effectually if it be applied at a black, than at a red or white heat. As the actual cautery blocks up the artery by a thick slough or eschar, there is always danger of a recurrence of the bleeding when this separates, and the surgeon must be on his guard about the sixth or eighth day lest it break out again.

4. **DIRECT PRESSURE** upon the bleeding part is a very efficient mode of arresting hemorrhage from small arteries. It is not, however, applicable to all parts of the body, as it is necessary that the vessel should have a bone adjacent to it, so as to afford a point of counterpressure; hence it cannot readily be employed in soft and moveable parts, as the throat or perineum. Pressure may be practised in various ways; sometimes the mere uniform compression of a bandage is sufficient to arrest the hemorrhage; thus oozing from a wound may often be stopped by laying down the flaps, and applying a bandage pretty tightly over them. Sometimes a weight applied upon this will tend still further to arrest the bleeding; as, for instance, by means of a shot or sand bag laid upon the part. In the case of bleeding from hollow cavities, as the rectum, vagina, or nares, the hemorrhage may be arrested by the pressure of a plug of sponge or lint, to which sometimes a styptic may advantageously be added. When the hemorrhage proceeds from the puncture of a small or moderate-sized artery, as of the temporal or brachial, pressure should be made against the adjacent bone with a graduated compress and bandage, and be continued for one, two, or three weeks, until complete consolidation of the wound takes place, the vessel becoming obliterated. The graduated compress should be at least an inch in thickness, and made of a series of pledgets of lint of a circular shape, gradually diminishing in size. It should be applied with its pointed end resting over the wound in the vessel. In applying it, care should be taken that the part on which the pressure is to be exercised has been thoroughly dried of all blood, and that the artery is commanded above the wound by a tourniquet, or by the pressure of an assistant's fingers. A piece of adhesive plaster should then be laid on, and a thick slice of a phial-cork, or a fourpenny piece, wrapped in lint, being placed on this, the graduated compress should be wrapped tightly over the whole. When applied in this way, pressure acts by causing adhesive inflammation and obliteration of the vessel at the point compressed.

5. **TORSION OF ARTERIES** for the arrest of hemorrhage, mentioned by Celsus, and revived by Amussat, Velpeau, and Thierry, has never found much favour amongst surgeons in this country. It may be practised in various ways. Thus, Amussat recommends that the artery be drawn out (about half an inch by one pair of forceps; that it then be seized at its attached point with another forceps, and that the end be twisted off by about half a dozen turns. Ericksen advises that the ends be not taken off, but merely twisted six or eight times, according to the size of the vessel. Thierry simply seizes the artery and twists it. There can be no doubt that hemorrhage from the largest vessel may be efficiently stopped by torsion, the artery being placed in the condition of one that is lacerated or torn through. The internal and middle coats are retracted, and the external one is twisted into a kind of valve beyond them. A coagulum next forms within the vessel, blocking up its extremity; inflammation then takes place, and, together with the coats of the artery, the twisted end sloughs off, and

the vessel becomes occluded up to the nearest collateral branch. The advantage that torsion is supposed to possess over the ligature is that, no foreign body being left in the wound, there is less suppuration, and a greater prospect of union by the first intention. This advantage, however, is more fanciful than real; the twisted end acts as a foreign body, and is as likely to interfere with union as the noose of a ligature. Torsion possesses the great disadvantage of being less safe, and less readily practised than the ligature on the larger arteries. Occasionally in operations, however, small arteries, as muscular branches, may advantageously be pinched or twisted once or twice in such a way as to arrest the bleeding from them.

6. *ACUPRESSURE*.—In consequence of the presence of the ligature in the wound exciting suppurative action along its track, and the end of the artery that is included in, and that projects beyond its noose, sloughing and acting as a foreign body, and thus still further exciting suppurative action, Dr. Simpson has proposed to arrest the hemorrhage from wounded or cut arteries, by the pressure of a needle passed across their course. By this method of treatment, "*Acupressure*," the employment of a foreign body likely to excite suppuration is entirely done away with, the end of the artery does not slough, and union by the first intention is accordingly promoted. The whole process consists in passing the needle *twice* through the substance of the wound, so as to compress together and close, by the middle portion of the needle, the tube of the bleeding artery a line or two, or more, on the cardiac side of the bleeding point. The only part of the needle which is left exposed on the fresh surface of the wound is the small middle portion of it, which passes over and compresses the arterial tube; and the whole needle is withdrawn on the second or third day, or as soon as the artery is supposed to be adequately closed, thus leaving nothing whatever in the shape of a foreign body within the wound, or in the tissues composing its sides or flaps. To produce adequate closing pressure upon any arterial tube which it is desired to constrict, the needle must be passed over it so as to compress the tube with sufficient power and force against some resisting body. Such a resisting body will be most frequently found, 1, in the cutaneous walls and component tissues of the wound; 2, sometimes in a neighbouring bone, or other resistant point, against which the artery may be pinned and compressed by the acupressure needle; and 3, in a few rare cases it may possibly be found in practice, that a second needle requires to be introduced to serve as a point against which compression may be made.

Most commonly simple compression against the flap itself seems perfectly sufficient, and that even in the amputation of the thigh, a thicker or deeper flap merely requiring a proportionately longer needle. In acting upon this mode, the surgeon may place the tip of the fore-finger of his left hand upon the bleeding mouth of the artery which he intends to compress and close; holding the needle in his right hand, he passes it through the *cutaneous* surface of the flap, and pushes it inwards till its point projects out to the extent of a few lines on the raw surface of the wound, a little to the right of, and anterior to his finger-tip; he then, by the action of his right hand upon the head of the needle, turns and directs its sharp extremity so that it makes a bridge as it were *across* the site of the tube of the bleeding artery, immediately in front of the point of the finger with which he is shutting up its orifice; he next, either with this same fore-finger of the left hand, or with the side of the extremity of the needle itself, compresses the locality of the bleeding arterial orifice and tube, and then pushes on the needle *with his right hand* so as to make it re-enter the surface of the wound a *little to the left* side of the artery; and, lastly, by pressing the needle

farther on in this direction, its point re-emerges through the cutaneous surface of the flap—the site of the tube of the bleeding artery being in this way left pinned down in a compressed state by the arc or bridge of steel that is passed over it. The needle thus passes first from and through the skin of the flap *inwards* to the raw surface of the wound, and, after bridging over the site of the artery, it passes secondly from the raw surface of the wound *outwards* again to and through the skin. Sometimes the needle will be best passed by the aid of the eye alone, and without guiding its course by the finger tip applied to the bleeding orifice. It compresses not the arterial tube alone, but the structures also placed over and around the site of the tube. When the needle is completely adjusted, all of it that is seen, and that not necessarily so, on the surface of the raw wound, is the small portion of it passing over the site of the artery (Fig. 67); while externally, upon the cutaneous surface of the flap, we have remaining exposed more or less of its two extremities, namely, its point and its head (Fig. 68). The rest of it is hidden in the structures of the flap or side of the wound. The degree of pressure required to close effectually the tube of an artery is certainly much less than medical practitioners generally imagine; but in the above proceeding the amount of pressure can be regulated and increased, when required, by the acuteness of the angle at which the needle is introduced and again passed out—the cutaneous and other structures of the flap serving as the resisting medium against which the needle compresses the arterial tube. If it were ever, perchance, necessary to produce greater compression than can be thus accomplished by the needle alone, this increased pressure could be readily obtained by throwing around the two extremities of the needle, which are exposed cutaneously, a figure-of-8 ligature, as in hare-lip, with or without a small compress placed between the arc of the ligature and the skin. In practice, however, the pressure of the needle upon the artery will—without any such external aid—be found to err more frequently, at first, in the way of excess than in the way of defect.



Fig. 67. Needle applied to Acupressure. Internal Surface of Flap.



Fig. 68. Needle applied to Acupressure. External Surface of Flap.

To compress an artery against a bone is somewhat more complicated, but not much so. We introduce from the cutaneous surface a long needle through the flap of the wound obliquely to near the site of the artery; and then, compressing against the bone, with the fingers of the other hand, or with the end of the needle itself, the part containing the artery, we make the needle, after passing over this compressed part, and after testing whether it has closed the vessel or not, enter into the tissues beyond, and, if necessary, even emerge from the cutaneous surface on the other side, at an angle somewhat oblique to that at which it entered; thus taking advantage of the consistency and resistance of the soft textures to make them push the needle with the necessary degree of force against the artery and bone. Arteries in particular parts require special adjustments and modifications to compress them against the neighbouring bone, which only anatomy and experience can point out.* The needle may be withdrawn at the end of two or three or four days, according to the size of the artery.

Of the value of this method of arresting hemorrhage in the case of small arteries, there can be little doubt. It has long been familiarly employed in

* Edinburgh Medical Journal, 1860, vol. 1.

restraining the hemorrhage from the coronary artery of the lip after operations for hare-lip; and in vessels such as this, the branches of the temporal, the digitals, &c., it is unquestionably as safe as well as a convenient and easy method of suppressing bleeding. But for arteries of large size, as the femoral, it yet remains to be shown that acupressure can be depended upon as a mode of restraining hemorrhage equally safe with ligature.

7. **LIGATURE** is the means to which surgeons commonly have recourse for the arrest of hemorrhage from wounded arteries.

The ligature had been occasionally and partially employed by the later Roman surgeons; but with the decline of surgery it fell completely into disuse, giving way to such barbarous and inefficient modes of arresting the hemorrhage as the employment of the actual cautery, the performance of operations with red-hot knives, the application of boiling pitch, or of molten lead, to the bleeding and freshly cut surface. About the middle of the sixteenth century it was revived or reinvented by that great luminary of the French school of surgery, Ambrose Paré. But so slowly did the ligature make way amongst surgeons, that Sharpe, surgeon to Guy's Hospital, writing in 1761, two centuries after its introduction into practice by Paré, found it necessary, in his well known work, entitled, "*A Critical Enquiry into the Present Stage of Surgery*," formally to advocate its employment for the arrest of hemorrhage from wounded arteries, in preference to styptics or the cautery, on the ground that "it was not as yet universally practised amongst surgeons residing in the more distant counties of our kingdom." What, it may be asked, was the reason that it took two centuries to promulgate the use of the simplest and most efficacious means we possess in surgery—a means that no surgeon could now for a day dispense with? The reason simply was, that surgeons were totally ignorant of the means employed by nature for the occlusion of arteries; that they consequently knew not how to apply a ligature to these vessels, or what kind of ligature should be used; and that, in their anxiety to avoid the recurrence of secondary hemorrhage, and to make all safe, they fell into the very errors they should have avoided, had they been acquainted with the physiology of the processes which nature employs for the closure of the artery and the separation of the thread.

Between twenty and thirty years after the time at which Sharpe wrote, we find that Hunter introduced that great improvement in the surgical treatment of aneurism—the deligation of the artery at a distance from the sac, and in a healthy part of its course; but this great accession to the treatment of a most formidable disease was but coldly received, and ran some risk of being lost to the world in consequence of the ill-success that attended the earlier operations. In Mr. Hunter's first operation, four ligatures were used, all of which were applied so slackly as merely to compress the artery for some distance, and to avoid too great a degree of pressure at any one point; the artery was denuded, so that a spatula could be passed under it. Although in his subsequent operations Mr. Hunter contented himself with employing but one ligature, yet sometimes the vein was included in this; and he did not draw the noose tightly for fear of injuring the coats of the vessel, in accordance with the doctrine of the day—surgeons generally at this time being haunted with the dread of injuring, and thereby weakening, the coats of the artery; and in order to avoid doing so, adopting modes of treatment that almost infallibly led to ulceration of the vessels and consecutive hemorrhage. The application of several ligatures of reserve, applied slack—the use of broad tapes—the interposition of plugs of cork, wood, *agaric*, or lead—of rolls of lint or plaster between the thread and the vessel,

were some amongst the plans that were in common use. And how can we be surprised that the patients perished of hemorrhage, and that ligature of the vessel was nearly as inefficient and fatal a means of arresting bleeding as the use of a cautery, or of a button of white vitriol?

Mr Jones, by an appeal to experiment, and by means of a series of admirably conducted investigations, showed that the very point that surgeons were anxious to avoid—the division of the coats of the vessel by the tightening of the noose—was that on which the patient's safety depended; he also pointed out the form and size of ligature that was most safe, the degree of force with which it should be applied, and the processes adopted by nature for the occlusion of the vessel. Then a more rational practice was introduced, and then for the first time surgeons had full confidence in the use of the ligature.

Principles of Treatment of Wounded Arteries.—The whole of the doctrine of the general treatment of wounded arteries by ligature may be included in two great principles: 1, *To cut directly down on the wounded part, and to tie the vessel there;* and 2, *To apply a ligature to both ends, if it be completely divided, or to the distal as well as the proximal side of the wound, if it be merely punctured.*

These principles of treatment were distinctly laid down by John Bell;* but, although this great surgeon inculcated forcibly these rules of practice, surgeons appear to have been led away by the erroneous idea of applying the Hunterian principles in the treatment of aneurism to that of wounded arteries, until Mr Guthrie, by his practice and precepts, and by adducing an overwhelming mass of proof to bear on this important question, recalled the attention of the profession to the proper and rational treatment of wounded arteries.

1. The principal reason in favour of *cutting down directly upon the wounded part of the injured vessel* is, that the ligature of the main trunk at a distance above it would only stop the direct supply of blood to the limb, but would not interfere with the anastomosing circulation: this finds its way readily into that portion of the vessel which is below the ligature, and the blood carried by it would consequently continue to escape by the distal aperture in the artery. Thus, though bright arterial blood may no longer jet from the upper part of the wound, blood which has become of a dark colour, in consequence of the changes to which it is subjected in its passage through the vascular net-work of the limb, will continue to well out from the lower aperture in the artery, entailing the necessity of further operative procedure to restrain its flow, and unless this be done, the patient will die of hemorrhage as surely, though perhaps not quite so speedily, as if no ligature had been applied. Thus, if a surgeon endeavour to arrest the flow of blood from a wound of the ulnar artery near the palm by ligaturing the brachial in the middle of the arm, and, when the blood bursts forth as furiously as ever, apply successive ligatures to the arteries of the fore-arm with as little success, he will at last, by the continued recurrence of hemorrhage, be forced to adopt the simple expedient that ought to have been had recourse to in the first instance—ligaturing the vessel at the point wounded, and thus he will at length succeed in arresting the bleeding.

Another reason for the practice now advocated is, that in some cases the surgeon cannot possibly know what artery is injured unless he seek for it in the wound itself. A large artery may, from the direction of the stab and the impetuous flow of blood that has followed it, appear to be wounded, when in reality it is only a minor branch that has been injured. Thus, for

* *Principles of Surgery*, vol. 1 pp. 550, 700. New edit.

instance, in hemorrhage from a stab in the axilla, which proved fatal, notwithstanding the ligature of the subclavian artery for supposed wound of the axillary, the long thoracic was found to be the vessel divided; so also the external iliac has been ligatured for supposed wound of the common femoral, when in reality it was the superficial external pudic that was injured.

The rule of cutting down on the injured part of the artery applies to all cases in which the wound is still open, whatever be its condition. However deep, inflamed, and sloughy the wound; however ill-conditioned and infiltrated with pus or blood the neighbouring parts may be, it may be stated as a general rule, to which, however, there are some exceptions, especially in wounds of the palmar arch, or of the secondary branches of the carotid, that there is no safety to the patient unless the vessel be cut down upon and tied at the part injured. This must always be done at any period after the receipt of the injury, so long as there is an external wound communicating with the artery. An operation of this kind is often attended with the greatest possible difficulty, not only owing to the hemorrhage that usually accompanies it and obscures the parts, but also in consequence of the inflamed, infiltrated, and sloughy condition of the tissues in the wound. In order to moderate the hemorrhage, the pressure of an assistant's fingers on the artery high up in the limb must not be trusted to; but a tourniquet should be applied so as completely to arrest the circulation through the limb, and thus to facilitate the discovery and exposure of the injured vessel, the wound being dry. A large probe should then be passed to the bottom of the wound; and, taking this as the centre, a free incision should be made in such a direction as may best lay open the cavity with the least injury to the muscles and other soft parts. After turning out any coagula contained within it, and clearing it as well as possible, the wounded vessel must be sought for. The situation of this may sometimes be ascertained at once by the gaping of the cut in its coats. In many cases, however, it is necessary to relax the pressure upon the artery, so as to allow a jet of blood to escape, that may indicate the position of the aperture. The ligature may then be applied by passing an aneurism-needle under the vessel, if it be partially divided; or, if it be completely cut across, by drawing forwards the end and ligaturing it, as in an open wound. In doing this, care must be taken that the ligature be really applied to the vessel, and that a portion of the sheath infiltrated with blood, or thickened by adherent coagulum, be not mistaken for the artery. In applying the ligature under the circumstances here indicated, viz., in a wound that is sloughy and suppurating, the tissues will necessarily in a great degree have lost their cohesion and firmness, and although the arterial tissue resists the disorganising influence of low inflammatory actions much longer than cellular or muscular tissue, yet it will also have become softened and less resisting. Hence the vessel must be isolated with gentleness and care, and the ligature very carefully tied—no undue force being used. The ligature will usually separate in such cases several days before the ordinary time. The incisions down to the wounded artery should generally be made on the side of the wound itself, and through the wound in the soft tissues covering it. Guthrie, however, advises, that in those cases in which the wound passes indirectly to the principal artery from the back or outside of the limb, the surgeon need not follow the track of the wound, but may cut down on the vessel where nearest the surface; and then, on passing a probe through the wound, the spot at which the artery has probably been wounded will be pointed out, which must then be ligatured in the way usual in cases of primary hemorrhage.

In *primary* hemorrhage from wound of an artery, no operation should be undertaken unless the bleeding be actually continuing. If the bleeding have been arrested, however furious it may have been, the surgeon should never go in search of the wounded vessel, nor undertake any operation, unless it burst forth again. A man was brought to the University College Hospital with a deep stab in the groin, directly in the course of the external iliac artery, a very large quantity of arterial blood had been lost, but the hemorrhage was arrested on his admission by the application of pressure, &c. From the great and sudden loss of blood it was supposed that the external iliac had been punctured, but it was not thought advisable to perform any operation unless hemorrhage recurred. The bleeding did not return, the wound healing without any further trouble. In *secondary* hemorrhage the case is different. There the vessel must be secured, even though bleeding have for the time ceased.

2 The second great principle in the treatment of wounded arteries is, that the *ligature* be applied to both ends of the vessel, if it be completely cut across; or on both sides of the aperture in it, if it be only partially divided.

The reason for this rule of practice is founded on physiological grounds as well as on practical experience. If the anastomoses of the part be very free, as in the arteries of the palm or fore-arm, bleeding may continue from the distal end, uninterrupted by the ligature on the proximal side of the wound. If they be less free, it will probably issue in a stream of dark-looking venous blood in the course of two or three days. After the collateral circulation has been sufficiently established, bright scarlet blood will burst forth from the distal aperture. Experience has shown that it is in this way that secondary hemorrhage from wounded arteries commonly occurs, the bleeding coming from the distal and not from the proximal end of the vessel.

In some cases the distal end is so retracted and covered in by surrounding parts, that it cannot be found in order to be ligatured. Under these circumstances, the best effect has resulted from plugging the wound from the bottom with a graduated sponge-compress. If an arterial branch happen to be divided so close to its origin that it cannot be secured, the case must be treated as one of puncture of the main trunk, which must be ligatured above and below the bleeding orifice.

Although advocating strongly the importance of the distal as well as the proximal ligature in all cases of wounded artery, I am aware that instances are on record in which the proximal ligature alone, and that even at a distance from the wound, has proved successful in arresting the hemorrhage; but I cannot do otherwise than regard those cases as accidentally successful, the distal end having been better plugged than usual with coagulum; and I am strongly of opinion that the rule of practice should be that which is laid down by John Bell, and so forcibly illustrated by Guthrie, viz. — That both ends of a wounded artery be sought for, and tied in the wound itself.

Application of the Ligature.—The mode of application of the ligature, and the kind of ligature to be used, vary according as, 1, the cut end of the artery has to be tied in an open wound, or as 2, the vessel has to be secured in its continuity.

1. When the *divided vessel* in an open wound has to be tied, as after an amputation, the mouth of the artery must be seized and drawn forwards (Fig. 69). For this purpose a tenaculum, or sharp hook, is not unfrequently used, and in many cases answers the purpose exceedingly well. There are, however, some objections to this instrument; thus, it occasionally seizes

other tissues with the artery, and, as it draws the vessel forwards by perforating its coats, it has happened that, an accidental puncture having been made by it behind the part to which the ligature is applied, ulceration of the

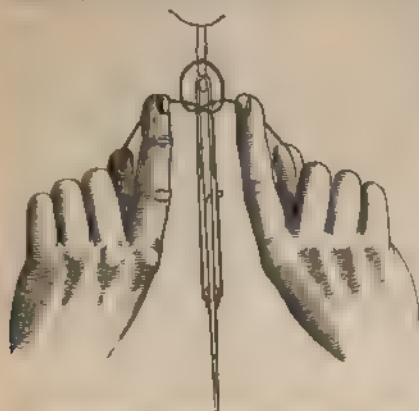


Fig. 69.—End of Artery drawn onwards. Application of Ligature.

vessel and subsequent hemorrhage of a fatal character have ensued, as I have seen happen in one case. The most convenient instrument for the purpose of drawing forward the artery, and one to which no objection whatever applies, is Liston's "bulldog" forceps. These have been conveniently modified by having the blades expanded just above the points (Fig. 70), so that the ligature can be slipped over the end of an artery that is deeply seated, as between bones or close to the interosseous membrane of the leg—a situation in which it is sometimes troublesome to tie a

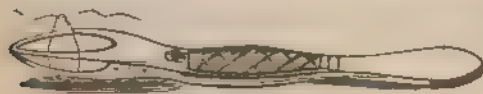


Fig. 70.—Liston's "Bulldog" Forceps.

vessel by any other means. In some cases the bleeding point may be so situated, that the ligature is most conveniently passed under and round it by means of an ordinary curved needle. The kind of ligature used must vary according to the size of the vessel. If this be small, full round twine; if large, dentist's silk, or compressed smooth whip-cord, should be employed; I always employ the latter in ligaturing the main artery of the limb. Before being used, the ligature should be well waxed, so that it may not be too limp; its strength should be tested by knotting it with a jerk, and, if found efficient, it may be cut up for use in pieces eighteen inches in length. In applying the ligature, care must be taken that it be put well beyond the cut end of the artery, that it clear the points of the forceps, and that it be tied tightly in a reef-knot, which does not slip



Fig. 71.—A Reef knot.

(Fig. 71). One end of the ligature should then be cut off about a quarter of an inch from the knot, and the other left hanging out of the wound. The ligature that secures the main artery should have both its ends knotted together, by way of distinctive mark. It is always better to leave one end of the ligature; if both be cut off, the nooses and knot left are apt to become enveloped by granulations or adhesive matter, and, after the healing process is well advanced, or perhaps completed, to give rise to suppuration in and re-opening of the wound. The ligature that hangs out of the wound acts as a seton, giving rise to a tract of suppuration along its course, and thus so far preventing union of the wound by the first intention. The end of the artery which is included in, and which projects beyond, the noose, sloughs, and thus acts as a foreign body in the wound. These inconveniences are inseparable from the use of the ligature, but may be materially lessened by the surgeon bringing the threads out at the innermost angle of

the wound, and thus allowing the discharges to escape at the most dependent part.

2. When the artery has to be ligatured in its continuity, but at the point wounded, it must be exposed by as careful a dissection as the state of the parts will admit. If a surgeon determine to apply a ligature at a distance from the injury, his anatomical knowledge will guide him to the vessel. This is usually done by cutting through the tissues in the course of the vessel; Hargrave, however, recommends that, in ligaturing arteries, the incisions should not be made parallel to the course of the vessel, but in an oblique or transverse direction over it, and this suggestion appears to me to be deserving of attention in some situations, more particularly in the ligature of the brachial at the end of the arm, or of the carotid at the root of the neck. The surgeon is usually guided to the vessel by some fixed line or point, as the edge of a muscle, which has a determined and constant relation to the artery. Thus in exposing the brachial, he cuts along the inner border of the biceps. In some cases, however, as in the ligature of the iliac arteries, no such certain anatomical guide exists, and then an imaginary line is drawn between two fixed points—as the umbilicus and the centre of Poupart's ligament—which becomes the guide to the course of the vessel. These "directing lines" should be carefully studied and kept in mind.

In making the first incision, the skin should be put on the stretch by the fingers of the left hand, or by those of an assistant. If the artery be superficial, or if there be parts of importance in its vicinity, the incision should not penetrate deeper than the skin. But if the vessel be deeply seated and no parts of importance intervene, it may be carried at once through the subcutaneous cellular tissue, until the fascia covering the artery is exposed. This must then be pinched up with the forceps, and opened by the edge of the scalpel laid horizontally. Through this opening a grooved director may then be passed, and the fascia incised on it, without risk to sub-

adjacent parts. The sheath of the vessel is now exposed by a little careful dissection; and the next step of the operation, which consists in exposing the artery and separating it from its accompanying vein, is one of great delicacy. This is done by

pinching up the sheath with the forceps and applying the knife horizontally (Fig. 72). The point should never be used, nor the blade turned downwards against the artery, as an incautious movement or the mere pulsation of the vessel might cause it to be wounded. The artery having thus been exposed, the surgeon seizes one edge of the sheath with the forceps, and, putting it on the stretch, gently separates the artery from its accompanying vein by teasing through the cellular connections with the end of the aneurismal needle, or with a director; being careful not to expose it to a greater extent than is absolutely

necessary for the passage of the ligature, lest subsequent sloughing of the vessel ensue, as a consequence of the destruction of the vascular connections between it and the sheath (Fig. 73).

In opening the sheath, care should be taken not to wound any small branch, lest the collateral supply be interfered with, and danger of secondary

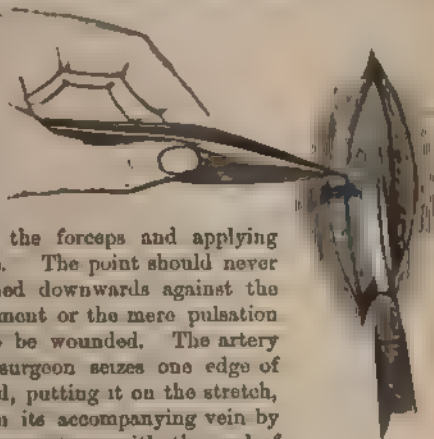


Fig. 72.—Exposure and Division of the Sheath.

femoral, in cases of pyemia (Fig. 79). In the distal end of the ligatured artery I have never seen any very distinct coagulum formed, either in the human subject or in dogs on which I have experimented, but merely small detached fragments of coagula and some plastic effusion.



Fig. 78 - Partial Absorption of Coagulum in Femoral Artery four days after Amputation.

The changes that take place in the *External Coat* are of the most important character. After the internal and middle coats have been cut through by the ligature, the external would not be able to resist the impulse of the blood, were it not strengthened and consolidated by the adhesive inflammation. The necessary inflammation is occasioned partly by the dissection required to expose it, and partly by the pressure and irritation of the ligature. Lymph is thrown out between the vessel and its sheath, matting together these parts, and often enveloping the noose and knot in an ovoid mass. Progressively with the effusion of lymph and consequent strengthening of the coats, the pressure of the noose causes gradual sloughing and ulceration of the part included in it. The mode in which the noose ulcerates its way through the external coat is of



Fig. 79 - Femoral Arteries, ten days after Amputation of Thigh, Death from Pyemia.

much importance, as on this depends in a great measure the success of the ligature. There are two sources of danger in connection with this process; either that the sloughing may be too extensive, or that the ulceration through the artery may take place before the adhesive plug is properly and firmly formed.

The chance of the sloughing being too extensive, principally arises from the artery being isolated and separated from its sheath to too great an extent during the dissection required to expose it, in consequence of which, its nutrient vessels being divided in great numbers, that portion of the coats of the vessel, deprived of its vascular supply, becomes sloughy; hence the danger of passing a spatula, large probe, or the handle of a scalpel under the artery, and also of applying several ligatures. Premature ulceration of the vessel most commonly occurs from the patient's constitution being in too debilitated a state to admit of healthy reparative action.

So soon as the ligature has ulcerated through that portion of the artery which is included in its noose, it becomes loosened and separates; frequently being thrown off with the discharges, or becoming detached on the slightest traction. The period of the separation of the ligature depends upon the size of the artery and the thickness of its coats. From the radial or ulnar arteries, it is usually detached by the eighth day; from the femoral, iliac, or subclavian, about the sixteenth or twentieth days. In some cases the ligature will continue attached for a much longer period than this, owing to the inclusion of a bit of a nerve or of muscular substance within its noose. In order to hasten the separation in these cases, moderate traction and occasional twisting of the ligature may be practised.

Collateral Circulation.—When the main artery of a limb has been ligatured, or in any other way occluded, it is only the direct flow of blood that

set up in the external coat may cause an effusion of lymph inside the vessel, yet that which is required to repair the breach occasioned by the division of the internal and middle coats, is the principal source of the plastic deposit. The changes that take place in the vessel after the application of a ligature require, however, to be more carefully studied.

The *Division of the Internal and Middle Coats* should be done evenly, smoothly, and completely, so as to leave a wound that will readily take on the adhesive inflammation. This is best done by a small round ligature, applied with such degree of force that the surgeon feels the coats give way under his finger. In this a *subcutaneous* section, as it were, is effected; and this, like all similar wounds, takes on adhesive action. The adhesion between the coats is much facilitated by the pressure of the ligature, which also acts as a support to the vessel.

The *Formation of the Internal Coagulum* in the proximal end is the most important part of the process. For the first four-and twenty hours after the application of the ligature there is little, if any, appearance of this. Usually about this time, if opportunity offer to examine an artery in the human subject, it will be found that a small nodule of lymph, of a yellowish or buff colour, has been deposited in the bottom of the cul-de-sac that is formed by the retraction and contraction of the cut ends of the inner and middle coats, so as to close up the extremity of the artery. About the second or third day, this coagulum will be found to have assumed a conical shape (Fig. 75), the base being made up of decolorised fibrine and exudation-matter, firmly adherent to the lower end of the artery; the middle and terminal portions of the coagulum, composed of hemorrhagic clot, and of a dark purple or morone colour, lie loose and floating in the artery, extending up as high as the first collateral branch. About the tenth day, the inflamed end of the vessel will be found to be



Fig. 75.—Femoral Artery six days after Amputation.



Fig. 76.—Femoral Artery six days after Amputation.

tightly and firmly contracted upon the enclosed plug (Fig. 76), the dark-coloured portions of which now begin to undergo a process of absorption. Between this period and the sixth week, the contraction of the vessel and the absorption of the free part of the plug go on simultaneously (Fig. 77), the interior of the artery becoming darkly stained by imbibition of the colouring matter of the coagulum. Lastly, the plastic base of the plug becomes incorporated with the contiguous arterial coats, and undergoes eventual transformation into fibro-cellular tissue.



Fig. 77.—Femoral Artery, six weeks after Amputation.

In some cases (Fig. 78), there is an imperfect formation of the internal plug, or even total absence of it, and not unfrequently secondary hemorrhage occurs as a consequence. This condition may arise either from want of plasticity in the blood, from an absence of the adhesive inflammation, or from the coats not having been properly cut through. In other cases, in consequence of suppurative action being set up in the artery, a kind of disintegration or liquefaction of the plug takes place after it has been formed. Thus I have seen happen in a case of ligature of the carotid artery, in which death occurred from visceral disease ten weeks after the operation; and in the

femoral, in cases of pyemia (Fig. 79). In the distal cul-de-sac of the ligatured artery I have never seen any very distinct coagulum formed, either in the human subject or in dogs on which I have experimented, but merely small detached fragments of coagula and some plastic effusion.



Fig. 74—Partial Absorption of Coagulum in Femoral Artery, ten days after Amputation.

The changes that take place in the *External Coat* are of the most important character. After the internal and middle coats have been cut through by the ligature, the external would not be able to resist the impulse of the blood, were it not strengthened and consolidated by the adhesive inflammation. The necessary inflammation is occasioned partly by the dissection required to expose it, and partly by the pressure and irritation of the ligature. Lymph is thrown out between the vessel and its sheath, matting together these parts, and often enveloping the noose and knot in an ovoid mass. Progressively with the effusion of lymph and consequent strengthening of the coats, the pressure of the noose causes gradual sloughing and ulceration of the part included in it. The mode in which the noose ulcerates its way through the external coat is of



Fig. 79—Femoral Artery, ten days after Amputation. (Died Death from Pyemia.)

much importance, as on this depends in a great measure the success of the ligature. There are two sources of danger in connection with this process; either that the sloughing may be too extensive, or that the ulceration through the artery may take place before the adhesive plug is properly and firmly formed.

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Collateral Circulation.—When the main artery, or in any other way occluded, it is only

is interrupted; the indirect supply which is conveyed into the limb or part, by the free anastomoses between the anastomosing vessels of the different portions of the arterial system, being sufficient to preserve its vitality, and to prevent the occurrence of gangrene. So free and ready are the communications kept up between different portions of the arterial system, that after the largest arteries in the body, such as the subclavian, iliac, and aorta, have been ligatured, sufficient blood to support life is at once conveyed into the parts supplied by them. This collateral circulation is most active and most readily maintained in early life, when the vessels are pliant and elastic, readily accommodating themselves to the increased quantity of blood that they are required to convey. As age advances, the vascular system becomes less elastic, and there is a greater difficulty in the establishment and maintenance of the collateral circulation. The anastomosing vessels which serve this purpose are invariably furnished by arteries contiguous to that which is ligatured, and come off from the same side of the body. Thus, for instance, after the ligature of the superficial femoral, it is by the profunda artery that the supply of blood is carried to the lower extremity. Thus also, when the common carotid is ligatured, the circulation to the parts it supplies is not maintained through the medium of the opposite carotid, although the anastomoses between the ultimate branches of the two vessels are so free upon the throat, upon the face, and within the cranium; but it is by means of the inferior thyroid and vertebral arteries (branches of the subclavian on the same side), which become greatly enlarged, that the supply of blood is kept up to the parts on the outside, as well as in the inside of the cranium.

The supply of blood that is sent to a limb, after the deligation of the main trunk, is at first but small in quantity; being merely sufficient for the maintenance of its vitality, but not enough for the continuance of the usual actions of the part. Hence, although the life of the limb may be preserved after the ligature of its artery, it becomes cold, and the patient is unable to move it for some time, the muscles appearing to be completely paralysed; gradually, however, the supply of blood increases, until having reached its usual standard, their normal vigour returns.

By what mechanism is this accomplished? It is due to three series of changes taking place: 1, in the capillaries; 2, in the anatomical anastomosing branches; and 3, in the trunk itself.

The capillaries are the first to enlarge; and this they appear to do by a vital process, and not in consequence of the mere increased pressure of the blood; the temperature of the limb often rising, in the course of a day or two, to its normal standard, and sometimes to two or three degrees beyond it, whilst a great sensation of heat is experienced in it by the patient. This period extends over several weeks; and, if opportunity be afforded of examining the limb during its continuance, the tissues generally will be found to be preternaturally vascular, admitting injection freely.

Concurrently with this increase of activity in the capillary system, the *anastomosing vessels* of this part enlarge, becoming serpentine, tortuous, and wavy, forming circles or an interlaced net-work. During this enlargement, much pain is often experienced, owing to the pressure of the enlarged vessels upon the neighbouring nerves. This form of collateral circulation commences by a general enlargement of all those muscular and subcutaneous secondary vessels of the limb, which can normally be readily distinguished by the naked eye. After this general enlargement has continued for some weeks, it tends to localise itself in a few of the principal anatomical anastomoses, until at last it is through their medium that the circulation is chiefly maintained. Thus for instance, after the ligature of the common carotid, the supply of

blood is ultimately conveyed by the inosculations between the superior and inferior thyroid arteries, and by the vertebral and basilar. When the subclavian is tied, the circulation of the upper extremity is carried on by the anastomoses between the posterior scapular and suprascapular, and the branches of the axillary artery distributed to the vicinity of the shoulder, and when the external iliac is tied, the blood is conveyed to the lower limb by the inosculations between the mammary and lumbar arteries, with the epigastric and circumflex ilii.

Jones pointed out the curious circumstance, that when two anastomosing branches approach one another, they split, before inosculating, into two or three ramusculi, which by uniting form a circle of anastomoses. Besides this kind of collateral circulation, Maunoir, Porta, and Stilling have noticed vessels running directly between the extremities of the obliterated trunk, forming species of arterial shoots, springing from the stump of the vessel.

The change that takes place in the *trunk* consists in its conversion into a fibro-cellular cord, from the point to which the ligature has been applied to the first large collateral branch below it (Fig. 80): here it becomes pervious again, and, receiving the blood poured into it through the different anastomosing channels, becomes again subservient to the purposes of circulation. Porta and Stilling have shown that, after a time, down the centre of this fibro-cellular cord a small tortuous central canal becomes developed, uniting the two distant ends of the divided artery. This is probably the last change that takes place in the establishment of the collateral circulation.



Fig. 80.—Change in the Trunk after Ligature.

The collateral circulation is occasionally not sufficiently free to preserve the integrity or vitality of the parts supplied by it. As a consequence of this, gangrene not uncommonly results, or the limb may become paralysed or atrophied. This condition is most frequently met with in old people, from ossification and rigidity of the arterial system; or it may happen as the result of copious hemorrhage, or of an extensive transverse wound of the limb dividing many of the anastomosing vessels. It more rarely happens that we find too great freedom of the anastomoses, so as to lead to a failure of the purposes for which the ligature has been applied, by the rapid admission of blood into the distal side of the vessel, thus perhaps occasioning secondary hemorrhage.

ACCIDENTS AFTER LIGATURE.

The accidents that may follow the application of the ligature to wounded arteries are *Secondary Hemorrhage*, and *Gangrene of the Limb*.

SECONDARY OR RECURRENT HEMORRHAGE.—By this is meant, bleeding from any cause after the application of a ligature. This accident may arise from a variety of circumstances, which may be divided into two great classes:—1. *Local Causes*, dependent on the Vessel or Ligature; and 2. *Constitutional Causes*, connected with some Morbid Condition of the Constitution or Blood, in consequence of which those changes which are necessary for occlusion of the artery do not take place.

Local Causes.—Among this class of causes may be mentioned any *imperfection in the application of the ligature*; as, for instance, its being tied too loosely, or with the inclusion of a portion of nerve, vein, or muscle; so also the accidental puncture of the artery above the point to which the ligature is applied.

The rush of blood through a neighbouring trunk, or collateral branch imme-

dently above the ligature, has been considered as likely to interfere with the formation of the internal plug; but too much importance should not be attached to this, for Porter has tied the carotid successfully within one-fourth of an inch of the brachio-cephalic artery. Bellingham has ligatured the external iliac close to its origin; and Key, the subclavian in the vicinity of a large branch, without secondary hemorrhage ensuing. But although the ligature may be safely applied near a branch on its proximal side, I think that the presence of a collateral branch in close proximity to the distal side of the ligature—more especially if it be one that serves to carry on the anastomosing circulation—will be found to have a decided tendency in preventing the occlusion of the distal end of the artery, and will thus act in favoring the occurrence of secondary hemorrhage.

The wound of a collateral branch immediately above the ligature, though it do not give rise to troublesome hemorrhage at the time, will, as I have seen, cause furious bleeding as the collateral circulation becomes established.

A diseased state of the coats of the artery at the point deligated, will occasion rapid sloughing and unhealthy ulceration of the vessel; those plastic changes which are necessary for its occlusion not going on within it. It has happened that fatal secondary hemorrhage has occurred from a large artery, such as the femoral, in consequence of a small atheromatous or calcareous patch having given way immediately above the ligature, a day or two after its application.

Constitutional Causes.—These act by preventing the formation of a clot within, and the deposit of plastic matter without, the artery; or if formed, causing their absorption in a few days. (Figs. 78 and 79.) Amongst the most common of these causes are those unhealthy states of the system in which inflammation of a diffused or erysipelatous character sets in, which is incompatible with plastic effusion. In these cases either no internal coagulum at all is formed, or if any is deposited it is weak, imperfect, and unable to resist the impulse of the blood; or, if it have already formed, it speedily becomes absorbed or disintegrated; offering no resistance to the impulse of the blood, and being washed away.

In some cases the secondary hemorrhage appears to be owing to an excited state of the circulation. The patient is restless, has a quick, irritable, and jerking pulse. Under such circumstances, bleeding is very apt to occur, and, if not too abundant, appears to give relief to the system.

The occurrence of erysipelas, phlebitis, or sloughing of the stump or wound, will prevent or arrest the necessary adhesive inflammation. Besides these conditions, there are certain states of the blood in which from disease, as *anæmia*, it has lost its plasticity, and cannot yield the products of adhesive inflammation. Secondary hemorrhage is especially apt to occur in cases of *pyæmia*, provided that disease assume a somewhat chronic character. The conditions of the blood in pyæmia being incompatible with the formation of a firm and plastic coagulum within the artery, the vessel continues or becomes open, and secondary hemorrhage will certainly occur. The sloughing action set up in a wound may extend to the larger arteries, and by destroying their coats occasion secondary hemorrhage. But it must be borne in mind that the arterial tissues are usually the last of the soft tissues to slough. An artery will continue to pulsate in a wound, preserving its integrity when all around it is slough and disorganisation.

Prevention.—The occurrence of secondary hemorrhage is usually somewhat gradual, and not without warning. The blood does not burst forth in a gush at once, but appears at first in a small quantity, oozing out of the wound and staining the dressings; it may then cease to flow for a time, but

breaks out again in the course of a few hours, welling up freely in the wound, and either draining the patient by repeated losses, attended by the phenomena that characterise hemorrhagic fever, or else exhausting him so that he falls a victim to some asthenic disease, such as pneumonia, erysipelas, or phlebitis. In other cases again, after a few warnings, it may burst out in a gushing stream that at once destroys life.

The opportunities which I have had of examining the state of the vessels in several cases of fatal secondary hemorrhage, lead me fully to concur with Guthrie and Porter, that the blood in the great majority of instances comes from the distal, and not from the proximal, side of the wound. The greater tendency in the distal end of the vessel to bleed, appears to arise partly from the less perfect occlusion of this portion of the artery, and partly from its greater liability to slough, in consequence of the ligature interrupting its supply of blood through the *vasa vasorum*. It is no objection to this opinion that the fatal hemorrhage is often of an arterial character; for, though it is true that the blood which is carried to the distal end is, for the first few days after the application of a ligature, of a venous hue, yet, after the collateral circulation is once established, it gradually assumes a more scarlet tint, and at last becomes completely arterialized.

Periods at which it occurs.—Secondary hemorrhage may come on at any time between the application of the ligature and the closure of the wound. There are, however, three periods at which it is particularly apt to occur:—1, a few days after the ligature has been applied; 2, about the period of the separation of the ligature; and, 3, at an indefinite time after its separation.

1. The hemorrhage which occurs a few days after the application of the ligature, arises either from some imperfection in the tying of the ligature; from disease in the arterial coats, causing them to give way; from sloughing; or from want of adhesive inflammation on the face of a stump: when from the latter cause, there is a general oozing or dribbling of blood from many points of the surface, rather than a gush from one orifice. In those cases in which the artery has been tied above the wound only, hemorrhage is very apt to occur at this time.

2. When hemorrhage occurs about the time of the separation of the ligature, it may arise from any of the causes already specified that interfere with the due formation of an internal coagulum, or that occasion ulceration and sloughing of the coats of the vessel. The occurrence of hemorrhage at this time is often connected with, or dependent upon, that peculiar irritability of the heart and arteries which has already been mentioned as a frequent cause of bleeding.

3. Lastly, in some cases in which the ligature has separated but the wound has remained open, the hemorrhage may take place either from the cicatrix in the artery being too weak to support the impulse of the blood; or from the coagulum being absorbed in the way already mentioned. The continuance of the open state of the wound after the separation of the ligature, is, I think, not improbably dependent upon a morbid condition of the coats of the vessel which eventually leads to hemorrhage. The length of time that will sometimes elapse between the separation of the ligature and the occurrence of hemorrhage is very remarkable; thus there is a preparation in St. Thomas's Hospital of a carotid artery, from which secondary hemorrhage took place in the tenth week after ligature; and South mentions a case of ligature of the subclavian, in which the thread separated on the twenty-seventh day, the fatal hemorrhage occurring in the thirteenth week.

The Treatment of Secondary Hemorrhage must be considered, as the

bleeding takes place, 1, from a Stump; and 2, from an Artery tied in its Continuity.

In all cases of ligature of arteries, care should of course be taken to prevent, if possible, this accident, by keeping the patient perfectly quiet, giving no stimulants, having the bowels kept open, and the secretions free, and avoiding any undue traction on the ligature itself.

In *primary* hemorrhage the rule of practice is, not to interfere by operation if once the hemorrhage have been arrested by other means. In *secondary* hemorrhage this rule of practice does not apply; but the surgeon may proceed to adopt effectual means for the prevention of the recurrence of the bleeding after the first outbreak, even though all flow of blood have ceased when he sees the patient; and he *must* do so, and that without delay, if the hemorrhage have recurred more than once. When once a repetition of *secondary* hemorrhage has taken place, the patient's condition becomes most critical; the efforts of nature can no longer be trusted to for the arrest of the bleeding, and the last and fatal gush may at any moment occur. Hence the surgeon must under such circumstances lose no time; there must be no dillyng, no hoping that the bleeding will not recur, no trusting to temporary and inefficient expedients, but the case must be at once and decisively taken in hand. Under no circumstances is a greater amount of coolness and more surgical knowledge required, than in adopting a decisive and immediate line of action in a case of *secondary* hemorrhage. There is no time for delay, no time for consultations, none for reference to books; but the surgeon must act at once on his own responsibility.

1. The treatment of *secondary* hemorrhage from a Stump will depend in a great measure on the degree of union that has taken place between the flaps, and on the situation of the stump.

When the hemorrhage occurs a few days after amputation, if there be but slight oozing, elevating the part, applying cold, and bandaging it tightly with a roller, so as to compress the flaps, will sometimes arrest the bleeding. If it continues, however, or become more severe, the flaps, which will have been diminished by the effusion of blood, must be separated, and the bleeding vessel sought for and tied. When the stump is sloughy, and the tissues softened, the ligatures will not hold; under these circumstances the application of the actual cautery to the bleeding points will arrest the flow of blood. If the oozing appear to be pretty general from the number of points, the flaps being somewhat spongy, I have succeeded in arresting the hemorrhage by clearing their surfaces thoroughly of all coagula, and then bringing them tightly together by means of a roller.

If the hemorrhage occur at a later period, after the tenth day, when tolerable union has taken place, and appear to proceed from the principal artery of the part, an effort may be made to arrest it by the application of the horse-shoe tourniquet, which occasionally will stop all further loss of blood; or, if the union that had taken place between the flaps have been broken through, the stump may be fairly opened up, the coagula turned out, and the bleeding vessel sought for and tied. If, however, notwithstanding the hemorrhage, the union between the flaps continue sound and firm, then the choice lies between three alternatives; 1, opening up the stump, clearing away coagula, and tying the bleeding vessels at their open mouths; 2, ligaturing the main artery just above the stump; 3, performing the Hunterian operation, and tying the vessel high up in the limb at a distance from the stump. The course to be adopted will, I think, in a great measure depend upon the stump with which we have to do; but as a general rule I prefer in these cases adopting the first alternative, placing a tourni-

quot on the limb, passing the finger into the stump, and breaking up all adhesions, which are often very firm; then turning out the mass of coagula, which will usually be found distending the flaps, clearing these thoroughly with a sponge, and then tying the bleeding artery. Besides the main artery that bleeds—one of the tibials, for instance, if it be a leg amputation—there will generally be very free oozing from many points. The more abundant of this may be stopped by the ligature passed, if the tissues are friable, by means of a nevus needle under the vessels. The rest will cease on the application of cold water and on raising the stump. The flaps may then be brought together by strips of plaster and a bandage, and will usually very readily unite.

Should, however, the stump be inflamed, sloughy and cedematous, and more particularly if it be merely the foot or hand that has been removed, then, instead of opening it up, and seeking for the bleeding vessel, deeply hid in infiltrated tissues, it will be better to tie the main artery of the limb just above the flaps, or wherever it can be most readily reached. In such cases, after amputation of the foot, I have successfully tied the posterior tibial low down just above the lower malleolus.

The third alternative, that of ligaturing the artery high above the stump, should, I think, be undertaken in those cases only where the amputation has been done close to the trunk, as at the shoulder-joint, or the middle or upper part of the thigh, and where consequently there is no length of limb to be nourished by the artery that is ligatured, and where opening up an almost cicatrised stump of very large size would inflict a greater shock upon the system, and more consecutive danger, than the deligation of an artery by an independent operation. Hence, although in no case of secondary hemorrhage from a leg stump below the knee would I ligature the femoral in preference to opening up the flaps and securing the vessels in them, yet in secondary hemorrhage, after the amputation of the thigh, the case might be different, and here, if good union had already taken place, and the stump were not distended by coagula, the main artery might be tied. In such cases it is clearly useless to ligature the superficial femoral, as the hemorrhage may, and most probably does, proceed from some of the branches of the profunda. Ligature of the common femoral is not very successful; and upon the whole it would, I think, be safer, if all other means have been tried and have failed, to deligate the external iliac just above Poupart's ligament. In disarticulation of the arm at the shoulder-joint, the subclavian artery must be tied, either above or just below the clavicle.

2. When the hemorrhage occurs after a ligature has been applied to the *Continuity of the Vessel*, whether for injury or disease, pressure must first be tried. With this view the wound should be plugged, and a graduated compress should be very firmly and carefully applied by means of a ring-tourniquet over the point from which the blood proceeds; in this way the bleeding may occasionally be stopped. Not unfrequently, however, this will prove ineffectual, the bleeding recurring from underneath. When this is the case, what course should the surgeon pursue? He may re-apply the compress once more with great care, after clearing away coagula, and drying the parts thoroughly; but should it again fail in arresting the bleeding, it is useless to trust to it again, as the hemorrhage will certainly recur, and valuable time and much blood will be lost in these fruitless attempts at checking it. The course that the surgeon should pursue in such a case as this, is a most anxious consideration, but one on which his mind should be clearly and decidedly determined, as there is but little time for reflection or consultation, and none for referring to authorities.

If the artery be situated on the trunk, as the subclavian, carotid, or one of the iliacs, there is nothing to be done but to trust to the plugging of the wound; and in the great majority of these cases the patient will die exhausted by repeated hemorrhage.

When the artery is situated in one of the limbs, more efficient procedures may be had recourse to. If it be one of the arteries of the upper extremity, the wound should be opened up, and an attempt made to tie both ends of the vessel again in this; should this fail, or not be practicable, the artery must be ligated at a higher point than that at which it had been previously tied, should the hemorrhage still continue, or be re-established, amputation is the only resource left.

In the lower extremity, the treatment of secondary hemorrhage occurring after ligature is replete with difficulty. Here I believe it to be useless to tie the artery at a higher point than that to which the ligature has been already applied, as gangrene invariably follows this double ligature of the arteries of the lower extremity: at least, in the two or three cases that I have seen in which recourse has been had to this practice, mortification of the limb has ensued; and in all the reported cases with which I am acquainted, a similar result has occurred. The treatment should vary according as we have the femoral artery or one of the tibials to deal with. If the hemorrhage proceed from the femoral, I should be disposed to cut down on the *bleeding* part of the vessel, treating it as a wounded artery, and applying a ligature above and below the part already ligated; an operation that would however necessarily be fraught with difficulty. Should this be impracticable, or not succeed in checking the hemorrhage, I think that we should best consult the safety of the patient by amputating at once on a level with or above the ligature. Although this is a severe measure, it is infinitely preferable to allowing him to run the risk of the supervention of gangrene, which will require removal of the limb under less favourable conditions. If the secondary hemorrhage proceed from one of the tibials, it would be useless to adopt either of the preceding alternatives. If we ligatured the superficial femoral, the bleeding would not be permanently controlled, or, if it were, gangrene of the limb would in all probability set in. at least, I know of no case in which this practice has been followed without mortification occurring. In a few rare instances, however, the ligature of the popliteal has, under such circumstances, succeeded, but it has also frequently failed, rendering secondary amputation necessary, and its success is a mere matter of chance. The depth at which the tibials are situated is so great, that it would be hopeless to go in search of, and to attempt the ligation of one of these vessels at the bottom of a deep, sloughy, infiltrated and inflamed wound. Under such circumstances, therefore, I think we should best consult the patient's safety by amputating the leg above the seat of wound. This is truly a severe measure; but the only other alternative that has, to my knowledge, ever succeeded, is the ligature of the popliteal; and as that, as has already been stated, has frequently failed, I think that as a rule we should best consult the safety of the patient by the removal of the limb at once.

If the hemorrhage occur from a wounded artery to which ligatures have already been applied above and below the seat of wound, the same treatment must be adopted as in those cases in which the bleeding takes place from the application of the ligature to the continuity of the vessel.

GANGRENE FOLLOWING LIGATURE.—After the ligature of the main artery of a limb, the collateral circulation is, under all ordinary circumstances, sufficient to maintain the vitality of the part supplied by the ligated

quet on the limb, passing the finger into the stump, and breaking up all adhesions, which are often very firm; then turning out the mass of coagula, which will usually be found distending the flaps, clearing these thoroughly with a sponge, and then tying the bleeding artery. Besides the main artery that bleeds—one of the tibials, for instance, if it be a leg amputation—there will generally be very free oozing from many points. The more abundant of this may be stopped by the ligature passed, if the tissues are friable, by means of a nevus needle under the vessels. The rest will cease on the application of cold water and on raising the stump. The flaps may then be brought together by strips of plaster and a bandage, and will usually very readily unite.

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ligature, though fortunately not of very frequent occurrence, is a source of considerable danger, being very apt to give rise to gangrene by the tension of the parts obstructing the anastomosing circulation. I have on two occasions seen gangrene of the fingers from this cause, follow a ligature of the vessels of the fore-arm.

The *abstraction of heat* from the limb, either directly by the application of cold, or indirectly by the neglect of sufficient precaution to keep up the temperature of the part, often occasions gangrene: thus Sir A. Cooper has seen mortification follow the application of cold lead-lotion to a limb in which the femoral artery has been tied; and Hodgson has witnessed the same result when the operation was performed at an inclement season of the year.

The *incautious application of heat* may, by overstimulating the returning circulation of the limb, especially about that period when the rising temperature is an indication of increased action in the capillary vessels, occasion mortification. In this way the application of hot bricks and bottles to the feet has given rise to sloughing; and Liston was compelled to amputate the thigh after ligature of the femoral artery, for gangrene induced by fomenting the limb with hot water.

The *application of a bandage*, even though very cautiously made, is apt to induce sloughing and gangrene. I have seen this happen when a roller was applied to the leg after ligature of the femoral artery, with a view of removing the edema.

The *Period of Supervention* of gangrene of the limb extends over the first three or four weeks after the ligature of the vessel. It seldom sets in before the third day, but most frequently happens before the tenth.

Character.—The gangrene from ligature of an artery is almost invariably of the moist kind, on account of the implication of the veins. The limb first becomes oedematous; vesications then form; and it assumes a purplish or greenish black tint, rapidly extending up to the seat of operation. In some cases, though they are rare, simple mortification of the limb comes on; the skin assuming a dull yellowish-white hue, mottled by the streaks that correspond to the veins, and becoming dry, horny, and shrivelled, about the extensive tendons of the instep.

Treatment.—Much may be done with the view of preventing gangrene. Thus, the limb should be elevated, wrapped up loosely in flannel or cotton-wadding, and laid on its outer side after the operation. If the weather be cold, hot-water bottles may be put into the bed, but not in contact with the limb. Should there be any appearance of stagnation of venous blood, the plan recommended by Guthrie, of employing continuous and methodical friction in a direction upwards for twenty-four hours, so as to keep the superficial veins emptied, may be practised.

When mortification has fairly set in, amputation of the limb should be had recourse to at once as the only chance of saving life, in all those cases in which the patient's constitutional powers are sufficiently strong to enable him to bear the shock of the operation. The limb should be removed at the seat of the original wound, or opposite the point at which the artery has been tied. In those cases, however, in which the gangrene follows injury of the femoral artery just below Poupart's ligament, Guthrie advises the amputation to be done below the knee, where it usually stops for a time. If the gangrene spread, with edema or serous infiltration of the limb, the amputation should be done high up; at the shoulder joint, or in the upper third of the thigh. In these cases a large number of vessels usually require ligature, having been enlarged by the collateral circulation.

vessel. In some cases, however, it happens that the condition of the circulation in the parts below the ligature is not compatible with their life.

Causes. — The causes influencing the occurrence of gangrene in this way are the Age of the Patient, the Seat of the Operation, and the various Conditions in which the Limb may afterwards be placed.

The influence of *age* is not, however, so marked as might *a priori* be supposed; for, although there can be no doubt that there is a less accommodating power in the arterial system to varying quantities of blood at an advanced period of life, and that there would be greater difficulty in maintaining the vitality of the limb after ligature of the artery in a man of sixty than in one of twenty-five; yet I find that, of thirty cases in which gangrene of the lower extremity followed the ligature either of the external iliac or femoral arteries, the average age of the patient was thirty-five years, as nearly as possible the mean age at which these operations, according to Norris's Tables, are generally performed. Of these cases of gangrene two occurred under twenty years of age, eleven between twenty and thirty, eight between thirty and forty, and nine above forty.

The *seat of the operation* influences greatly the liability to gangrene, which is much more frequent after the ligature of the arteries in the lower than in the upper extremity.

Besides these predisposing causes, gangrene after ligature may be directly occasioned by a *deficient supply of arterial blood*. In some cases this may arise from the collateral vessels being unable, in consequence of the rigidity of their coats, to accommodate themselves to the increased quantity of blood they are required to transmit; or they may be compressed in such a way by extravasation as to be materially lessened in their capacity. In other instances again, the existence of cardiac disease may interfere with the proper supply of blood to the part.

Great *loss of blood*, either in consequence of secondary hemorrhage, or in any other way, before or after the application of the ligature, is often followed by gangrene, and is almost certain to be attended by this result if a second ligature has been applied to a higher point in the lower extremity. That a diminution in the quantity of blood circulating in the system may, under the most favourable circumstances, become a cause of gangrene after the ligature of the artery, is illustrated by the statement of Hodgson, that soon after the introduction of the Hunterian operation into Paris, it was the custom to employ repeated venesection in the cases operated on, the consequence of which was that mortification was of frequent occurrence.

A more common cause of gangrene is the *difficulty experienced by the venous blood in its return from the limb*. This difficulty always exists even when no mechanical obstacle impedes its return, being dependent on the want of a proper *vis à tergo* to drive it on. The propulsive power of the heart, which is the main agent in the venous circulation, is greatly diminished by being transmitted through the narrow and tortuous channels of the anastomosing vessels. This difficulty to the onward passage of the venous blood may, if there exist any cause of obstruction in the larger venous trunks, be readily increased to such an extent as to choke the collateral circulation, and so cause the limb to mortify. This mechanical obstacle may be dependent upon the occlusion of the vein by inflammation excited within it opposite the ligature, by its transfixion with the aneurism-needle, or by its accidental wound with the knife in exposing the artery. When such an injury, followed by inflammation, is inflicted on a vein, which, like the femoral, returns the great mass of blood from a limb, gangrene is the inevitable result.

The *supervention of erysipelas* in the limb after the application of the

and ruptures, or the external wound, which had been temporarily plugged by coagulum, gives way ; or else they inflame and suppurate, pointing at last like an abscess, and, on bursting, giving rise to a sudden gush of blood, which may at once, or by its rapid recurrence, prove fatal. In some cases, a subcutaneous breach is made in the coagulated and plastic boundary, and, the blood becoming infiltrated into the cellular tissue of the limb or part, syncope, gangrene, and death are the results.

Treatment.—The treatment of these cases must be conducted on precisely the same plan as that of an injured artery communicating with an external wound ; the only difference being, that in the case of the diffused traumatic aneurism, the aperture in the artery opens into an extravasation of blood instead of upon the surface. We must especially be upon our guard not to be led away by the term *aneurism* that has been applied to these cases, and not to treat such a condition, resulting from wound or subcutaneous laceration, by the means that we employ with success in the management of that disease. In a pathological aneurism the blood is contained within a sac, which, as will hereafter be shown, is essential for the occurrence of those changes that are necessary for the cure of the disease. In the diffused traumatic aneurism there is no sac, properly speaking ; and hence these changes to which a sac is necessary, cannot take place. I doubt whether there is a case on record in which the Hunterian operation for aneurism, applied to the condition now under consideration, has not terminated in danger or death to the patient, and in disappointment to the surgeon.

The proper treatment of these cases consists in laying open the tumour by a stroke of the scalpel, removing the coagula, dissecting or rather clearing out the artery, and ligaturing it above and below the wound in it. This operation, easy in description, is most difficult and tedious in practice. The bleeding is often profuse ; the cavity that is laid open is large, ragged, and partially filled with coagula ; it is often with much difficulty that the artery is found under cover of these, and in the midst of infiltrated and disorganised tissues ; and when it is found, it is not always easy to get a ligature to hold. In performing this operation, the artery must, if possible, be compressed between the tumour and the heart ; if it cannot be so commanded, the surgeon must be ready to apply his finger to the wound in the artery at the moment when the sac is laid open, in order to arrest the gush of blood that takes place from the open orifices. The application of a ligature to the distal end of the vessel, if it be completely divided, is especially difficult. Should it not be practicable, the application of the actual cautery, or pressure by means of a sponge-tent or graduated compress, will be found the best means of arresting the hemorrhage.

Circumscribed Traumatic Aneurism differs entirely from the diffused in its pathology and treatment, inasmuch as it possesses a distinct sac. There are two varieties of this form of aneurism.

1. In the first variety, a puncture is made in an artery, or the vessel is ruptured subcutaneously, as perhaps in the reduction of an old dislocation : blood is extravasated into the adjoining tissues ; and, if there be an external aperture, this circumscribes the blood. The blood that is extravasated becomes surrounded and limited by a dense layer of plastic matter poured out into the spaces of the neighbouring tissues, and forming a distinct circumscribed sac, which is soon lined by layers of fibrine deposited from the blood that passes through it. This tumour, usually of moderate size, and of tolerably firm consistence, pulsates synchronously with the beat of the heart, and has a distinct bruit, both of which cease when the artery leading to it is compressed. This form of circumscribed traumatic aneurism most commonly

CHAPTER XIII.

TRAUMATIC ANEURISM AND ARTERIO-VEIN WOUNDS.

TRAUMATIC ANEURISM.

WE have hitherto discussed the treatment of an injured artery having an open wound communicating with it. It often happens, however, that the case is not so simple as has been described, but that, in addition to the wound in the vessel, we have a subcutaneous extravasation of blood, with more or less pulsation, thrill, and bruit, from the projection into it of the blood from the wounded vessel. This extravasation constitutes a *Traumatic Aneurism*, and may arise in three ways. 1. There may be an oblique or indirect puncture into the artery, the blood furnished by which partly escapes from the wound, partly extravasates itself into the tissues around the vessel. 2. The puncture in the integuments may have been closed by plaster or bandage; and then no blood escapes externally, but, the wound in the artery continuing patent, the blood is poured out into the substance of the limb or part. 3. There may have been no external wound, but the artery may have been punctured or torn across, subcutaneously, by the spicula of a fractured bone, by a violent strain or twist of the limb, by the injury inflicted in a dislocation, or by the surgeon in his efforts to reduce it.

These traumatic aneurisms, in whatever way arising, are of two kinds, the *Diffused* and the *Circumscribed*.

DIFFUSED TRAUMATIC ANEURISM.—This consists of an effusion of blood poured out by, and communicating with, the wounded or ruptured artery; limited in extent by the pressure of surrounding parts, and partially coagulating in the meshes of the broken down cellular tissue. It has no sac; and its boundary, which is ill defined, is composed partly of this coagulum, and partly of plastic matter, effused by the tissues into which it is poured out, and has a constant tendency to extend by the pressure of the fluid blood, which continues to be projected into the centre of the tumour.

This form of traumatic aneurism is indicated by a subcutaneous, soft, and semi-fluctuating tumour, often of very considerable size, composed of extravasated blood. At first the skin covering it is of its natural colour, but it gradually becomes bluish, and is thinned by the pressure to which it is subjected. If the wound in the vessel be rather large and free, there will be a distinct pulsation in the tumour synchronous with the beat of the heart, accompanied by a thrilling, purring, or jarring sensation, and often a distinct and loud bruit. In other cases, again, if the injured artery be small, or if the wound in it be oblique, and of limited size, there may be no distinct pulsation or bruit; the tumour being either indolent and semi-fluctuating, or having an impulse communicated to it by the subjacent artery. In those cases also in which the artery is torn completely across, or in which the blood that is effused coagulates very rapidly, the ordinary aneurismal bruit and pulsation may be very obscure or quite absent. In such cases, the diagnosis of the true nature and gravity of the tumour may usually be made by observing that the pulse in the arteries at a lower point is absent, and that there is great cedema of the limb.

These tumours, if left to themselves, rarely undergo spontaneous cure, but they either increase in size until the integument covering them sloughs

open, the cragula turned out, and the artery ligatured as in the ordinary diffused aneurism.

ARTERIO-VENOUS WOUNDS.

The wound in the artery may communicate with a corresponding one in a contiguous vein, giving rise to two distinct forms of disease—*Aneurismal Varix* and *Varicose Aneurism*. These preternatural communications, which were first noticed and accurately described by W. Hunter, most commonly happen at the bend of the arm, as a consequence of the puncture of the brachial artery in bleeding; but they have been met with in every part of the body in which an artery and vein lie in close juxtaposition, having been found to occur as a consequence of wounds of the subclavian, radial, carotid, temporal, iliac, femoral, popliteal, and tibial arteries. The two forms of disease to which the preternatural communication between arteries and veins gives rise, differ so completely in their nature, symptoms, effects, and treatment, that a separate consideration of each is required.

ANEURISMAL VARIX results when, a contiguous artery and vein having been perforated, adhesion takes place between the two vessels at the seat of injury, the communication between them continuing pervious, and a portion of the arterial blood being projected directly into the vein at each beat of the pulse. Opposite to the aperture of communication between the two vessels, which is always rounded and smooth, the vein will be found to be dilated into a fusiform pouch, with thickened coats. The veins of the part generally are considerably enlarged, somewhat nodulated, tortuous, and thickened. The artery above the wound is dilated; below, it is usually somewhat contracted. These pathological conditions are evidently referable to a certain quantity of the arterial blood finding its way into the vein, and distending and irritating it by its pressure and presence, and less consequently being conveyed by the lower portion of the artery.

The *Symptoms* consist of a tumour at the seat of injury, which can be compressed by pressure upon the artery leading to it, or by compressing its walls. If subcutaneous, this tumour is of a blue or purple colour, of an oblong shape, and will be seen to receive the dilated and tortuous veins. It will be found to pulsate distinctly with a tremulous jarring motion, rather than a distinct impulse. Auscultation detects in it a loud and blowing, whistling, rasping, or hissing sound, usually of a peculiarly harsh character. This sound has very aptly been compared by Porter to the noise made by a fly in a paper bag, and by Liston, to the sound of distant and complicated machinery. The thrill and sound are more distinct in the upper than in the lower part of the limb, and are most perceptible if it be allowed to hang down so as to become congested. Besides these local symptoms, there are usually some muscular weakness, and diminution in the temperature of the part supplied by the injured artery.

Treatment.—As this condition, when once formed, is stationary, all operative interference should be avoided, an elastic bandage merely being applied. Should a case occur in which more than this is required, the artery must be cut down upon and ligatured on each side of the wound in it.

VARICOSE ANEURISM.—In this case the openings in the artery and vein do not directly communicate (see Figs. 83 and 85), but an aneurismal sac is formed between the two vessels, into which the blood is poured before passing into the vein.

The *Pathological Condition* of this form of injury consists of a circumscript false aneurism, communicating on one side with the artery, and on the other with the vein, which is always in a state of varix, as represented in

occurs from punctured wounds of small arteries, as the temporal, plantar, palmar, radial, and ulnar.

The *Treatment* to be adopted depends upon the size and situation of the artery with which the tumour is connected. If the artery be small, and so situated that it can be opened without much subsequent inconvenience to the patient, as on the temple or in the fore-arm, it should be laid open, the coagula turned out, and the vessel ligatured above and below the wound in it. If the tumour be so situated, as in the palm, that it would be difficult and hazardous to the integrity of the patient's hand to lay it open, the Hunterian operation for aneurism should be performed, as was successfully done in the case (Fig. 81) in which the brachial was ligatured for an aneurism of this kind in the ball of the thumb, following serious injury to the hand from a powder-flask explosion.



Fig. 81 — Circumscribed Traumatic Aneurism in Ball of Thumb.

It is but rarely that this form of traumatic aneurism is connected with a large artery; when it is, the vessel may be ligatured above, but close to the sac, in the same way as in the next variety. If this form of traumatic aneurism have increased greatly in bulk, so that the skin becomes thin and discoloured, or if inflammation ensue, and symptoms of impending suppuration take place around it, then it would be useless to ligature the artery above the tumour, as this would certainly give way, and secondary hemorrhage ensue. Here the proper course is to lay open the sac, turn out the contents, and tie the artery above and below the part that is wounded.

2. The next form of circumscribed traumatic aneurism is of rare occurrence, and usually arises from a small puncture in a large artery, as the axillary or the carotid. This bleeds freely; but, the hemorrhage being arrested by pressure, the external wound and that in the artery close. The cicatrix in the artery gradually yields, forming, at the end of weeks or months, a tumour which enlarges, dilates, and pulsates excentrically, with distinct bruit, having all the symptoms that characterise an aneurism from disease, and having a sac formed by the outer coat and sheath of the vessel. It is at first soft and compressible on being squeezed, but becomes harder and firmer, and cannot be so lessened after a time. It consists of a distinct circumscribed sac, formed by the dilation of the cicatrix in the external coat and sheath of the artery, no blood being effused into the surrounding tissues.

The *Treatment* will vary according to the size of the tumour. If this be small or but moderate in size, it consists in the ligature or compression of the artery leading to the sac, in accordance with the principles that guide us in the treatment of aneurism from disease; though, from the healthy state of the coats of the vessel, the artery may be ligatured as near as possible to the sac.

As there is a distinct cyst or sac in these circumscribed aneurisms, the changes that will be described in the chapter on the Treatment of Aneurisms in general, take place; the tumour gradually becoming consolidated, and eventually absorbed. Should, however, the aneurism have attained an enormous magnitude, or should it, from being circumscribed, have become diffused by the rupture of the sac, then the tumour must be laid freely

communication between an artery and vein; besides this, there is a blowing or bellows-sound, dependent on the aneurismal disease. These signs are most perceptible when the limb is in a dependent position; and the sounds can often be heard in the veins at a considerable distance from the seat of injury. There is also some impairment in the nutrition and temperature of the parts supplied by the injured vessels. As the disease advances, the aneurismal tumour lying between the artery and vein continues to increase in size, and to become hardened by the deposition of laminated fibrine. If left to itself, it would probably continue to enlarge until sloughing of the integuments covering it, followed by hemorrhage, took place. In some cases, the aperture of communication between the vein and sac becomes closed, and the aneurism is converted into one of the false circumscribed variety.

Treatment—The treatment of this disease must be conducted on different principles from those that have been laid down as required in the ordinary circumscribed traumatic aneurism; the difference depending upon the fact, that in the varicose aneurism there is always a double aperture in the sac, and that thus the proper deposition of laminated fibrine necessary for its occlusion cannot take place. The sac of such an aneurism may be compared to one that has been ruptured, or accidentally opened, in which we could consequently not expect the occurrence of those changes that are necessary for the cure of aneurism by the Hunterian operation.

In a varicose aneurism, consequently, the sac must be freely incised, and the artery tied on each side of the puncture in it. This procedure may, unless the surgeon be careful, and properly understand the pathology of this disease, be attended by some difficulty (Fig. 85). After the first incision has been made through the integuments, the dilated vein will be laid open, and an aperture will be seen at the bottom of the vessel, from which arterial blood may be made to issue. If an attempt be made to find the artery immediately below this aperture, the surgeon will be disappointed, for the sac of the circumscribed aneurism intervenes between the two vessels. That this aperture leads into the sac, and not into the artery, may readily be ascertained by introducing a probe into it, which will be seen to be capable of being carried sideways, as well as upwards and downwards, to a considerable extent, and in different directions altogether out of the course of the artery. In order to expose this vessel properly, a probe-pointed bistoury must be introduced into this opening, and the sac of the false aneurism slit up to its full extent, the coagula turned out, and the puncture in the artery sought for in the bottom of the cavity that has been exposed; this may now readily be made visible by the escape of a jet of arterial blood on relaxing the pressure on the upper part of the artery; a ligature must then be passed above and below the wound, and the cavity lightly dressed with lint.

CHAPTER XIV.

WOUNDS OF SPECIAL ARTERIES.

CAROTID ARTERY AND ITS BRANCHES.—Wounds of the *Carotid Artery*, and of its primary and secondary divisions, are of more frequent occurrence in civil practice than similar injuries of any other set of arteries in the body, in consequence of the neck being so frequently the seat of suicidal attempts. The hemorrhage from wounds of the main trunk is so copious as often to be immediately fatal. In the event of a surgeon being at hand, both ends of the bleeding vessel must be at once ligatured. Should the hemorrhage, whether primary or secondary, proceed from a deep branch, as the internal maxillary, deep temporal, or internal carotid, so situated as not to admit of the vessel being exposed and ligatured as the seat of wound, the ordinary rule of practice of tying a wounded artery as the seat of injury must be departed from, and the common carotid tied in the neck.

In consequence of the speedy fatality of the wounds of the carotid artery and its branches, *Traumatic Aneurisms* are rarely met with in this situation; they do, however, occasionally occur, and the records of surgery contain at least six instances of the kind, in each of which the common carotid was tied, and the patient ultimately recovered.

Aneurismal Varix of the Internal Jugular Vein, dependent on puncture of it and of the carotid artery, usually the result of sword-thrusts in the neck, is apparently of more frequent occurrence than traumatic aneurism in this region; probably owing to the close proximity of the vein rendering it difficult for the artery to be wounded on the outer or anterior sides, without first perforating that vessel. The symptoms presented by cases of this kind, though offering the general characteristics of aneurismal varix, yet have several points that are worthy of special remark. The wound of the vessels has been in every instance followed by the effusion of a large quantity of blood into the loose cellular tissue of the neck; the extravasation acquiring even the size of a child's head, and threatening immediate suffocation. As this extravasation subsided, the ordinary characters of aneurismal varix began to manifest themselves. The period at which these symptoms first made their appearance varied somewhat in the different cases, but they always occurred within four or five days of the receipt of the injury. In none of the cases did the disease appear to shorten life, or to occasion any dangerous or inconvenient effects, with the exception of some difficulty in lying on the affected side, and occasional giddiness or noise in the head on stooping.

Varicose Aneurism does not appear to have been met with in this situation. No operation is admissible in these affections.

Traumatic Aneurism of the Temporal Artery, and of its branches, occasionally occur as the result of partial division of these vessels in cupping on the temple; two cases of this kind I have met with, in both of which the disease was readily cured by laying the tumour open, turning out its contents, and tying the artery on each side of it.

Hemorrhage from the *Deep Arteries of the Face*, as in gun-shot injuries, if too copious to be restrained by cold, requires the ligature of the common or external carotid.

SUBCLAVIAN ARTERY.—A wound of the subclavian artery may almost

generally be looked upon as fatal; though, in consequence of the manner in which it is protected by the clavicle, these injuries can scarcely occur except from gun-shot violence. From the rapidly fatal nature of wounds of the subclavian artery, *Traumatic Aneurisms* in this situation are not met with; but when the artery passes into the axilla below the margin of the first rib, they are not of unfrequent occurrence.

Aneurismal Varix of the Subclavian Vein, resulting from wound of the artery in this situation, has been seen, notwithstanding the separation that exists between the two vessels until they reach the acromial angle of the subclavian space. These injuries have likewise usually been the result of sword-thrusts, and do not admit of any surgical interference.

AXILLARY ARTERY. In *Open Wounds of the Axillary Artery and of its branches*, the rule of practice consists in cutting down upon the bleeding vessel wherever it may be situated, and ligaturing it on each side of the wound. It must be borne in mind that, the arterial branches given off between the lower edge of the first rib and the fold of the axilla being very numerous, a punctured wound of the axilla or side of the chest may injure one of these vessels; though from its course, and the free flow of arterial blood that has followed the stab, it may be supposed that the axillary artery itself has been punctured. The particular vessel injured can only be ascertained by following up the wound, and ligaturing the artery that furnishes the blood.

In some cases, however, the state of the parts may be such, that it may be impossible to trace the artery at the depth at which it is situated, or even to expose it in a mere superficial situation, as in the stump after amputation at the shoulder-joint. Under these circumstances, the rule of ligaturing an artery at the seat of injury may be departed from, and the main trunk should be tied either above or below the clavicle; and the success of this operation has been sufficient to justify our having recourse to it, rather than exhaust the patient by any prolonged attempts at the ligature of the vessel in the open wound, though I think that this ought first to be attempted. Of 15 cases in which the artery has been ligatured either above or below the clavicle, for hemorrhage from wounds in the axilla or from stumps, I find that 9 were cured and 6 died. Although the success is about equal in whichever situation the vessel be tied, I should certainly give the preference to the supraclavicular operation, owing to the greater facility of its performance, and the comparative absence of collateral branches at the seat of ligature. In some cases, however, especially after amputations at the shoulder, the clavicle is pushed up at its acromial end, and then the artery might be best reached below the clavicle, under or through the pectoral muscles.

Traumatic Aneurism in the Axilla is not of unfrequent occurrence, arising directly from gun-shot wounds, or from the thrust of a knife, sabre, or other pointed weapon. In some cases the injury arises from a subcutaneous rupture of the vessel, the patient stretching out and straining his arm in an attempt to save himself from falling, and feeling a sudden snap in the axilla, which is followed by the formation of a rapidly diffused aneurism.

There are several cases on record in which axillary aneurism has resulted from violent attempts made by the surgeon in the reduction of old standing dislocations of the head of the humerus. Thus Pelletan mentions a case of this kind, in which the tumour, being supposed to be emphysematous, was opened, and the patient perished of hemorrhage. Warren relates a case of diffused axillary aneurism resulting from rupture of the artery, in consequence of the surgeon attempting to reduce a dislocation of the humerus by using his foot as a fulcrum in the axilla, but without taking off his boot.

Gibson has related three cases of axillary aneurism following rupture of the artery, in the attempt to reduce old standing dislocations with the pulleys. These cases are of much interest to the surgeon, as showing the necessity for great caution in the use of powerful extending force in the reduction of old dislocations, adhesions having probably formed between the artery and head of the bone.

Some of these traumatic axillary aneurisms have a tendency to diffuse themselves with great rapidity, filling up the whole of the hollow of the arm; it, and extending under the pectorals, even up around the shoulder. In other cases again, when more circumscribed, the disease may get well spontaneously, as happened in cases recorded by Van Swieten, Sabatier, and Hodgson. In other instances again, the disease has remained stationary for years, or has even undergone consolidation under medical treatment. It cannot, however, be considered sound practice to leave a traumatic aneurism of this artery without surgical interference, after the ordinary dietetic and hygienic plans of treatment have failed in effecting a cure, for it may at any time become rapidly diffused, or inflame and suppurate.

The *Treatment* of traumatic axillary aneurism must have reference not only to whether it is diffused or circumscribed; but if diffused, whether it be of recent origin, or have originated from puncture or from subcutaneous rupture or laceration of the vessel as a consequence of dislocation, fracture, blow, or strain.

When a *Diffused Traumatic Aneurism* of recent origin, rapid formation, and dependent upon puncture of the artery, is met with in the axilla, the treatment must be conducted in the same way as that of a wounded artery, without extravasation, in this situation. As Mr. Guthrie very justly observes, it can make no difference whether the puncture in the skin has healed or not—the condition of the artery must be the same. The tumour should be laid open, the coagula turned out, the artery sought for, and ligatured where wounded. There is, however, danger after this operation, either of secondary hemorrhage coming on from the seat of wound, by blood conveyed through the collateral vessels, which open into the subscapular and circumflex arteries; or else of the limb falling into a state of gangrene. In either case, amputation of the shoulder and through the aneurismal extravasation is the only practice that holds out a chance of life to the patient.

In those cases of diffused traumatic aneurism of the axilla that arise from subcutaneous rupture or laceration of the artery, the condition of parts is essentially the same as in a case of an open wound of the vessel, with the exception of the existence of no external aperture in the integuments. In these cases a tumour of considerable size, hard or fluctuating, according to the state of coagulation of its contents, will form with more or less rapidity. If it have formed very quickly, the artery being torn across, and the blood coagulating as it effused, it will not present the ordinary aneurismal signs, but may merely resemble an ordinary extravasation; from this, however, it may be distinguished by the loss of the pulse at the wrist, and by the oedema of the arm. If it form slowly, the blood continuing fluid, there will be the usual signs of aneurism, such as thrill, pulsation, and a gushing hot sensation. In all these cases, there is much oedema of the arm, with a tendency to inflammation, suppuration, and sloughing of the tumour and the parts amongst which it lies, with perhaps gangrene of the limb itself.

Treatment.—In such a case the choice would lie between treating the injury as that of a wounded artery by direct incision, or ligaturing the vessel above the clavicle. The ligature of the vessel above the clavicle has been done

three times, with only one recovery, two of the patients dying of gangrene and secondary hemorrhage. In the successful case, secondary hemorrhage had occurred; and gangrene of the arm, which threatened, was prevented, and the patient saved, by having amputation at the shoulder joint performed. The result, therefore, of this operation is so little promising, that few surgeons would be disposed, in the face of these facts, to repeat it.

The only other alternative consists in treating the ruptured artery on the same principle as a wounded one, disregarding the accidental complication of the subcutaneous accumulation of a few ounces or pounds of blood. This undoubtedly is the proper surgical principle on which to act in these cases. Its adoption has been strongly urged by Guthrie, and its advantage has been demonstrated by the success attending it in several cases in which it has of late been adopted by Paget, Syme, and others. The operation consists in compressing the subclavian above the clavicle, either by the direct pressure of the finger, or, as was done by Mr. Syme in his case, by previously making an incision over it, through which it could be more readily commanded; then laying the tumour open by a free incision through the anterior fold of the axilla and the pectoral muscles, turning out the coagula, and seeking for and ligaturing the artery at both ends. Yet it must be remembered, that the distal extremity of the torn vessel will probably bleed freely, owing to the open anastomoses round the shoulder.

Circumscribed Traumatic Aneurisms of the Axillary Artery are not uncommonly of slow formation, existing for several months or years before they require operation, although resulting from punctured wound of the armpit. In chronic cases such as these, the aneurism is necessarily provided with a firm and distinct sac, and approaches closely in its characters to the pathological form of the disease.

The Treatment here cannot be conducted on the principles that guide us in the management of a wound, or of a diffused aneurism of recent occurrence of this artery; for not only is the circumscribed aneurism provided with a sac, but the vessel at the point injured would very probably be found so have undergone changes that would render it little able to admit or to bear the application of the ligature. It would be softened, thickened, and lacinated, with perhaps a wide funnel-shaped aperture leading into the sac, which would be closely incorporated with the neighbouring parts. But, indeed, the treatment of this form of circumscribed traumatic aneurism by the ligature of the artery on the proximal side of the sac, has been found to be attended with remarkable success. In eight recorded cases in which this operation has been performed, not one fatal result has been noted. In all, the aneurism arose from stab or gun-shot wounds, and had existed for various periods, between two weeks and four years. In four of the cases the artery was ligatured above, and in four below the clavicle; and in one case of each category there was suppuration of the sac.

The particular point at which the artery should be ligatured must depend upon the condition of the tumour. If this be of large size, or arise from the upper part of the axillary artery above or immediately below the pectoralis minor muscle, there is no choice but to ligature the vessel above the clavicle. Usually, however, the principal increase in the tumour takes place in a direction downwards and forwards under the great pectoral muscle, the portion of the artery immediately below the clavicle appearing to be free from disease, the question would arise as to whether this part might not be selected for the application of the ligature; and as the results of both operations have hitherto been equally favourable, this must rather be determined

by the peculiarities in each case than on more general grounds. Most surgeons, I think, would however prefer ligaturing the artery above the clavicle, as being a simpler proceeding than tying it below that bone; which, moreover, has the disadvantage of bringing the scalpel into very close proximity with the sac, which, were it to stretch upwards under the pectoralis minor to a greater extent than could be discernible externally, might possibly be opened by the knife, as has even happened in operating above the clavicle. It has been recommended to apply the ligature between the sac and the origins of the subscapular and posterior circumflex arteries, above the former and below the latter; but this is an anatomical impossibility, if the aneurism be situated above the lower border of the axilla.

Compression of the artery on the distal side of the tumour has succeeded in curing the disease in a case that was under Dr. Goldsmith, of Vermont.

BRACHIAL ARTERY.—The hemorrhage from *Wounds of the Brachial Artery* may sometimes be arrested by the employment of methodical compression, but usually it requires the ordinary ligature on each side of the aperture.

This vessel may occasionally be the seat of *Traumatic Aneurism*, in consequence of a puncture received in venesection. This accident, which was formerly of frequent occurrence when venesection was practised by professed phlebotomists, now very rarely happens. Should a surgeon be so unfortunate as to puncture the brachial artery in this way, he may prevent injurious consequences by keeping up a proper degree of pressure, by means of a graduated compress applied immediately on the occurrence of the accident. With this view, the fingers, hand, and fore arm having been very carefully padded and bandaged, a well-made graduated compress should be firmly applied over the seat of puncture, and retained there for at least ten days or a fortnight. Should the aperture in the artery not be closed in this way, either a circumscribed false aneurism, a varicose aneurism, or an aneurismal varix will form, according to its situation in relation to the vein.

In the *Circumscribed Traumatic Aneurism* at the bend of the arm, following a wound of the brachial artery, we have the usual soft or semi-solid pulsating tumour, which can readily be emptied on pressure, and possesses more or less bruit. This disease may be treated in one of three ways: 1, by compression upon or above the tumour; 2, by ligaturing the artery leading to it; or 3, by cutting through the sac, and deligating the vessel on each side of the aperture in it.

The compression of the tumour has often been successfully practised. It may be done by means of a graduated compress on the tumour, and the application of a ring-tourniquet over the artery; the tumour becoming consolidated, and gradually undergoing absorption. In employing compression great care must be taken, however, not to induce sloughing of the tissues over the tumour by sudden and too forcible pressure. The limb should be carefully bandaged up and maintained in the semi-flexed position. Should this plan not succeed, we must be guided in our ulterior measures by the particular conditions of the case. If the tumour be of recent origin, soft and compressible; or, though of longer duration, large, with a thin sac, and danger of becoming diffused, it should be treated by direct incision, and the artery be deligated on each side of the wound in it. Should, however, the tumour be small, or but of moderate size, and the sac be tolerably thick and firm, so as to admit of the deposit of laminated fibrine, we may treat it by deligation of the brachial artery, either in the middle of the arm, or, as Anel did with success, immediately above the tumour. In the event, however, of the disease not being cured in this way, incision of the sac must be had recourse to, as I have known to be necessary in a case in which the brachial

artery was tied above the tumour, which was large, with a thin sac, the pulsations returning in a few days, and the tumour continuing to enlarge.

Varicose Aneurism, at the bend of the arm, presents the ordinary character of the disease. Occasionally, though rarely, it would appear that the aperture of communication between the aneurismal sac and the vein becomes closed, and thus the varicose is converted into the ordinary circumscribed traumatic aneurism.

The *Treatment* of this affection must be conducted on different principles from that of the ordinary circumscribed variety; for whatever be the density of the sac, it is never, as has already been explained (pp. 189-90), a perfect one, having always an opening into the vein which would prevent its proper closure by the deposit of laminated fibrine. In four cases related by Sabatier, which were treated by Anel's operation, amputation became necessary in two; and, in the other cases, the operation by incision of the sac was required before a cure could be effected. The sac must therefore be laid open, and the vessel tied on each side of it in the way that has been recommended in the treatment of varicose aneurism, and with the caution there laid down. If the varicose aneurism be converted, after a few days, into the circumscribed form, the aperture into the vein becoming occluded, ligature of the artery above the sac may be successfully employed, or compression may succeed in curing the disease.

In *Aneurismal Varix* of the arm, a roller and compress are all that can be required.

ARTERIES OF THE FORE-ARM AND PALM.—These vessels are very commonly wounded by pieces of glass, earthenware, or knife-cuts. In every case the bleeding point must be cut down upon, and both ends of the vessel tied. This rule is peculiarly imperative in this situation, on account of the freedom of the anastomosis through the palmar arches. In many of these cases the bleeding is at first very free, but, being arrested by pressure, does not break out again until eight or ten days have elapsed; when, the arm being much infiltrated with blood, inflamed, and swollen, double ligature of the vessel, at the seat of injury, has to be practised under somewhat difficult and unfavourable circumstances.

Traumatic Aneurism of the Radial and Ulnar Arteries usually assumes the circumscribed form, owing to the pressure employed at the time of injury containing the extravasation. If it be small and recent, and situated superficially at the lower part of the fore-arm, or if it be in any way diffused, the better plan is to cut down upon and through the tumour at once, ligaturing the vessel on each side. If, however, the aneurism be deeply seated amongst the mass of muscles at the upper part of the fore-arm, near the elbow-joint, the wound having healed, and the soft parts covering it being healthy and firm, the advice given by Mr. Liston appears to be most judicious—rather than cutting through the muscles, and detaching their connectives, he recommends that the aneurism should be left to attain some consistence, and then that the brachial artery be secured in the mid-arm. In such cases as these, also, compression of the brachial with moderate pressure on the tumour itself has effected a cure.

Wounds of the Palmar Arches must unfrequently occur from the breaking of glass or china in the hand, or stabs from some pointed instrument, and are always troublesome to manage. If the surgeon see the case shortly after the infliction of the wound, he may endeavour, by enlarging the aperture to a moderate extent, and with due attention to the tendons and nerves of the part, to secure the bleeding vessel. Should he fail in doing this, which he certainly will if it be the deep arch that is injured, a graduated com-

press must be well and firmly applied. If this be properly done, it will very commonly be an effective means of arresting the hemorrhage. If it be loosely and ineffectually put on, it will be worse than useless. The proper mode of putting on this compress is as follows. A tourniquet having been applied on the brachial artery, the wound must be carefully cleared of all foreign bodies, wiped dry, and lightly touched with the nitrate of silver. A wooden splint is then to be put on the back of the hand and the lower part of the fore-arm; each finger is then to be separately and carefully bandaged, and the tails of these finger-bandages must be attached to the splint at the back of the hand. A firm well-made graduated compress is now to be placed with the apex downwards on the wound, so as to bring and press the edges together, and securely bandaged against it. The circulation through the limb should still, if possible, be controlled with a ring-tourniquet, applied on that artery above the wrist which appears most to correspond with the artery wounded, or, better still, on the brachial itself; or the elbow may be forcibly flexed, and the fore-arm bandaged to the arm in this position, so that the hand rests upon the shoulder. The compress and limb must be left undisturbed for at least five or six days, when, the brachial being compressed, the dressings may be taken off, and the state of the palm examined. Should the wound be healing and look well, the hand-splint and compress may be re-applied; but should the face be sloughy and infiltrated with a hemorrhagic tendency, it will be useless again to resort to compression, and recourse must be had to other means.

Should an ineffectual attempt have been made to arrest the primary hemorrhage, or should the case be not seen until several days have elapsed, when secondary hemorrhage has occurred, and the palm has become infiltrated and swollen, pressure can no longer be borne upon the seat of injury, and it is useless to endeavour to search for the injured vessel in the midst of sloughy and infiltrated tissues, through a narrow wound which cannot be enlarged without danger of disorganising the hand. Under these circumstances, it is necessary to deviate from the ordinary rule of practice in wounded arteries, and the Hunterian operation must be performed. The surgeon may either tie both arteries above the wrist, or at once deligate the brachial. Both methods of treatment have their advocates. I prefer the simultaneous ligature of the two arteries of the fore-arm, just above the wrist, where they are superficial and very easily reached. In several cases under my care, the radial and ulnar, immediately above the hand, have been tied at the same time with complete success, and I have never seen a case in which this operation has failed; but should it do so, or should hemorrhage occur after this, as might happen in the case of an enlarged interosseous artery, the surgeon must have recourse to compression or ligature of the brachial.

Circumscribed Traumatic Aneurism in the Palm is by no means of frequent occurrence. It may, however, follow wounds of the palmar arches. In such a case as this, it would be clearly out of the question to lay open the sac, and to search for the injured vessel in the midst of the aponeurotic and tendinous structures of the hand. It would consequently be necessary, either to tie the radial and ulnar arteries immediately above the wrist, or to ligature the brachial in the upper arm. The latter plan should be preferred; as, were the first mode of treatment put into practice, the sac might continue to be fed by the interosseous artery, as happened in a case of Roux's, in which the patient died of hemorrhage from the palmar aneurism after the ligature of both arteries of the fore-arm. In the case represented (fig. 81), Liston successfully ligatured the brachial in the mid-arm, after compression upon it had failed to effect a cure.

FEMORAL ARTERY AND ITS BRANCHES.—The hemorrhage from these arteries when wounded is always very profuse. In all cases, ligature of the wounded vessel at the seat of injury should be practised.

If a *Infused Traumatic Aneurism* have already formed, the artery should be commanded by a tourniquet, as it passes over the brim of the pelvis, the sac laid open, and the bleeding vessel sought for and tied. Guthrie has collected a great number of cases, which prove incontestably that the general principles of treatment in wounded arteries must not be departed from, when the arteries of the groin or thigh are wounded. On the contrary, the facility with which in most cases the circulation is kept up, and the readiness with which secondary hemorrhage comes on as a consequence of the free anastomoses in this situation, render the rule of practice of applying a ligature on each side of the wound in the vessel peculiarly stringent in all recent arterial wounds in this part of the body. Secondary hemorrhage and gangrene of the limb are the great sources of danger here. When gangrene is imminent, or has come on, amputation is necessarily the sole resource. With regard to secondary hemorrhage, supervening after ligature of the artery at the seat of injury, there is, I think, no safe course but removal of the limb. Where the artery has been tied higher up, as, for instance, when the external iliac has been ligatured for recent wounds or traumatic aneurisms in the groin or upper part of the thigh, the hemorrhage appears to have returned, or gangrene to have supervened in all the cases. This fact was remarkably illustrated in the Crimean war. Thus, Dr. Macleod states that the French in one hospital at Constantinople ligatured the femoral at a distance from the wound for secondary hemorrhage seven times, and that all the cases

If the traumatic aneurism have assumed a *circumscribed* character, it must be treated on the principles laid down for this form of the disease, the supplying artery being ligatured above the tumour; and cases are not wanting in proof of the success of this practice.

It occasionally, though rarely, happens that a *Varicose Aneurism* is formed in the groin or upper part of the thigh, as the result of wound of the artery and vein in this situation. It usually presents the ordinary characters of this disease, but some peculiarities have occasionally been met with. Thus, in a case related by Horner, there was a wavy motion in the femoral vein on the uninjured side, arising from the blood in the wounded vessel communicating a thrill upwards to that contained in the vena cava. In a case related by Dr. Morrison, it is stated that a tumour, as large as the human uterus at the third month of pregnancy, communicated with the injured vein.

The *Treatment* of this disease is exceedingly unsatisfactory; of four cases in which the external iliac artery was tied, a fatal termination occurred in every instance, two of the patients dying of gangrene of the limb, and the remaining two of secondary hemorrhage and consecutive pneumonia. It has consequently been proposed by Guthrie that the tumour be laid open, and the artery secured above and below the aperture in it. As this plan has never been fairly put in practice, it would perhaps be useless to speculate on the chances of success likely to attend it; yet we must bear in mind, that laying open an aneurism of this kind in the groin is a very different matter from adopting the same procedure at the bend of the arm, or in a situation where the surgeon can readily command the artery on the proximal side of the sac. The gush of blood from so large an artery as the common femoral would be so great that, with whatever rapidity the operation were performed, there would be considerable risk of the patient suffering a fatal

hemorrhage, before the vessel, matted and incorporated as it would be with surrounding parts, could be separated and secured; and the ligature of the vessel would probably be followed by gangrene of the limb.

Recent wounds and traumatic aneurisms of a diffused kind, connected with the *Arteries of the Leg and Foot*, require to be treated by the free exposure of the bleeding orifice in the vessel, and its inclusion between two ligatures. In doing this, if the wound be situated in the posterior tibial or peroneal artery, the surgeon will have to cut freely by the side of or through the muscles of the calf. This he must do in the direction of their fibres, injuring them by transverse incision as little as possible; and, by taking the track of the wound as his guide, the bleeding vessel will at last be reached, and must then be tied in the usual way. Such an operation practised on a person with a muscular limb that is infiltrated with blood and inflammatory effusions, is in the highest degree difficult; and, deterred by these difficulties, surgeons have often attempted to arrest the hemorrhage by the ligature of the superficial femoral or popliteal arteries. The French more particularly adopt Aclt's operation in such cases, ligaturing the popliteal; and though this practice has occasionally been successful, as happened in a case in which I saw the popliteal ligatured for consecutive hemorrhage from a wound of the posterior tibial artery, by my respected master, Samuel Cooper, and in another instance in which Dupuytren successfully ligatured the femoral for a diffused traumatic aneurism of the posterior tibial, from wound with a pistol-ball, yet I fully concur with Mr. Guthrie in deprecating it as contrary to good surgery, and, with him, regard the success that has occasionally followed these operations as purely accidental. In secondary hemorrhage from the deep arteries of the leg, compression of the superficial femoral should be tried, the limb being at the same time bandaged and elevated. Should these means fail in arresting the bleeding, no more time must be lost, and the surgeon should never hesitate to amputate the patient's limb. In no other way do I believe that the patient has a fair prospect of safety.

Small Circumscribed Aneurisms are occasionally met with in the foot, in consequence of the wound of one of the plantar arteries, as in operations for club-foot. If pressure have failed in preventing or curing the disease, the only course left to the surgeon is to lay the tumour open, and to ligature the artery on each side in the usual way.

GLUTEAL ARTERY.—*Traumatic Aneurisms of the Gluteal Artery* are of less frequent occurrence than might *a priori* have been imagined, from the situation of the vessel exposing it to injury. These aneurisms may acquire an enormous size. In John Bell's celebrated case, the tumour is said to have been of "prodigious size," and to have contained eight pounds of blood. In Mr. Syme's case the tumour was as large as a man's head at the base, occupied the whole hip, and rose into a blunt cone.

CHAPTER XV.

ENTRANCE OF AIR INTO VEINS.

The Entrance of Air into a Wounded Vein, though an accident of rare occurrence, is one that occasions such peculiar and alarming symptoms, that it becomes necessary to be acquainted with the circumstances attending it; and its study is the more interesting to the practical surgeon, as it is chiefly in the course of operations that this condition occurs.

In surgical practice, we meet only with *spontaneous admission* of air into the circulation. This was first observed in the year 1818, in a case in which the internal jugular vein was opened during the removal of a large tumour from the right shoulder by M. Beauchesne. The investigation of this subject is consequently a comparatively recent matter, in which the labours of the Communicators of the French Academy are conspicuous, and the names of Magendie, Amussat, Cormack, and Wattmann, are distinguished.

RESULTS OF EXPERIMENTS ON ANIMALS.—As cases of the entry of air into the veins comparatively seldom occur in man, it is necessary to study the phenomena accompanying it on the lower animals. It has long been known to physiologists that the forcible introduction of air into the circulation would kill an animal; and Morgagni, Valsalva, Bichat, and Nysten, have made this a subject of observation and experiment. The death of the animal in these cases appears to be dependent partly upon the quantity of air injected, and partly on the rapidity with which it is thrown in. Bichat supposed that a single bubble injected into the circulation killed the animal with the rapidity of lightning; but this is erroneous, as shown by Nysten. I have on several occasions injected two or three cubic inches of air into the jugular vein of a dog without producing death, though much distress resulted. The rapidity with which the air is thrown in exercises a considerable influence upon the result. If blown in quickly, a small quantity may kill; if thrown in slowly and gradually, a large quantity may be injected without destroying life, the blood appearing to dissolve and carry away the gaseous fluid. In experiments which I have made on the subject, I have observed the following phenomena in cases where death was produced.

On exposing the internal jugular vein low in the neck, and puncturing it at a place where the flux and reflux of the blood are plainly discernible, there is perceived in the first inspiratory effort made by the animal after the wound, a peculiar lapping, or gurgling liquid, hissing sound; the nature of the sound depending partly on the size and the situation of the opening in the vessel. At the same time, a few bubbles of air are seen to be mixed with blood at the orifice in the vein. The entrance of the air is immediately followed by a struggle during the deeper inspirations, in which fresh quantities of air gain admittance, the entrance of each portion being attended by the peculiar sound above described. On listening now to the action of the heart, a loud churning noise will be heard, synchronous with the ventricular systole; and the hand will, if applied to the parietes of the chest, perceive at the same time a peculiar bubbling, thrilling, or rasping sensation, occasioned by the air and blood being, as it were, whipped together between the *communis carnis* and *chordæ tendinæ*. As the introduction of air continues, the circulation becomes gradually more feeble and languid; the heart's action, however, being fully as forcible as natural, if not more so.

The animal soon becomes unable to stand ; if placed upon its feet, it rolls over on one side, utters a few plaintive cries, is convulsed, extrudes the fæces and urine, and dies. If the thorax be immediately opened, it will be seen that the heart's action is continuing regularly and forcibly, and that the pulmonic cavities, though filled, do not appear distended beyond their ordinary size.

Death occurs, as I have shown in a paper on this subject, published in the 158th number of the *Edinburgh Medical and Surgical Journal*, in consequence of the air and blood being beaten up together in the right cavities of the heart into a spumous froth, which cannot be propelled through the pulmonary vessels ; hence there is a deficient supply of blood to the brain and nervous centres, and fatal syncope comes on, attended usually by convulsions.

SPONTANEOUS ENTRY OF AIR INTO THE VEINS OF MAN is attended by two distinct sets of phenomena, one of a local, the other of a constitutional character.

Local Phenomena.—These consist in a peculiar sound, produced by the entrance of the air, and in the appearance of bubbles about the wound in the vein. The sound is of a hissing, sucking, gurgling, or lapping character, and never fails to indicate the dangerous accident that has occurred. When once heard, whether in man or the lower animals, it can never be mistaken. It has fortunately fallen to my lot to hear this sound in the human subject on one occasion only—that of a patient who had attempted suicide by cutting his throat. The internal jugular being wounded, was being raised for the purpose of having a ligature passed under it ; at this moment a loud hissing and gurgling sound was heard, some bubbles of air appeared about the wound, the patient became faint, and greatly oppressed in his breathing. The ligature was immediately tightened, the faintness gradually passed off, and no bad consequences ensued.

The *Constitutional Effects* are usually very marked. At the moment of the entry of the air, the patient is seized with extreme faintness, and a sudden oppression about the chest ; he usually screams out, or exclaims that he is dead or dying, and continues moaning and whining ; the pulse becomes nearly imperceptible, and the heart's action labouring, rapid, and feeble ; death commonly results, but not instantaneously, in many cases at least. Thus Beauchesne's patient lived a quarter of an hour after the occurrence of the accident ; Mirault's between three and four hours ; and Clemot's several hours. Amongst the other recorded fatal cases, I have not been able to find any but vague statements as to the length of time during which the patients survived.

If the patient survive the immediate effects of the accident, he may probably recover without any bad symptoms, as happened in the case to which I have referred as occurring at the University College Hospital, and in an instance recorded by B. Cooper. The presence of the air in the pulmonic capillaries would appear in some cases to act as an irritant, and to induce fatal pneumonia or bronchitis, as happened to the patients of Roux and Malgaigne.

Cause.—The cause of the spontaneous entry of air into the veins has been very completely investigated and determined by the French Commission. If we open a large vein at the root of a dog's neck, near the thorax, in which the venous pulse, or flux and reflux of the blood, is perceptible, we shall see that air rushes in at each inspiration—but only at this time—never gaining entry during expiration. This is owing to the tendency to the formation of a vacuum within the thorax, more particularly in the pericardium, during

inspiration. This suction action, or "venous inspiration," is confined to the large vessels in and near the thoracic cavity, being limited by the collapse of the coats of the veins at a little distance from this. If the veins were rigid tubes, it would extend throughout the body; but, as they are not, it ceases where the coats collapse. It is indeed limited to that part of the root of the neck and the axilla where the venous flux and reflux are perceptible; and the space in which it occurs has been termed the "dangerous region." But, under certain circumstances, air may spontaneously gain admittance at points beyond this.

It is well known that what is called by the French writers the "canalisation" of a vein, or its conversion into a rigid uncollapsing tube, is the condition which is most favourable to the introduction of air into it. Indeed, except in those situations in which there is a natural movement of flux and reflux of the blood in the veins, this accident cannot occur unless these vessels be canalised, or, in other words, prevented from collapsing. This canalisation of the vessel may be occasioned in a variety of ways. Either the cut vein may be surrounded by indurated cellular tissue, which will not allow it to retract upon itself, but keeps it open, like the hepatic veins; or the coats of the vessel may have acquired, as a consequence of inflammation or hypertrophy, such a degree of thickness as to prevent their falling together when divided. Then, again, the principal veins at the root of the neck have, as *Berard* has pointed out, such intimate connections with the neighbouring aponeurotic structures, that they are constantly kept in a state of tension, so that their sides are held apart when they are cut across. The contractions of the platysma and other muscles of the neck may likewise, as *Sir C. Bell* has shown, have a similar effect. In removing a tumour, also, that is situated about the neck, the traction exercised upon its pedicle may, if this contain a vein, cause it to become temporarily canalised; and the incomplete section of the vessel, especially in a transverse direction, must prevent the approximation of the sides of the incision in it, which will be rendered open and gaping by the retraction of the surrounding tissues. This patency in the incision in the vein is apt to be increased by the position that is necessarily given to the head and arm, in all operations of any magnitude about the shoulders and neck. Lastly, the introduction of air into a vein will be favoured by the vessel being divided in the angle of a wound, the vein being, when the flaps that form that angle are lifted up, rendered open-mouthed and gaping.

On looking over the reports of cases in which air gained admittance into the veins during operations, it will be found that these vessels were always in one or other of the above-mentioned conditions. Thus, in *Beauchesne's* case, air was introduced in consequence of incomplete division of the external jugular, immediately above the right subclavian, whilst in a state of tension, during the removal of a portion of the clavicle. In a case that occurred to *Dupuytren*, a large vein connected with a tumour, and communicating with the jugular, was cut at the last stroke of the scalpel, whilst the tumour was being forcibly drawn up. The vein was found to be adherent to the sides of a wound, so that it remained gaping when cut. In a case related by *Delpech*, there was hypertrophy of the axillary vein, causing it to gape like an artery. In *Castani's* case there was incomplete section of a vein, which opened into the subscapular, whilst the tumour was being raised up. In *Roux's* case, a vein in the neck was opened, whilst a tumour, which was being removed from that region, was being forcibly raised in order to dissect under it. *Thiers* saw the accident occur in consequence of the incomplete division of the external jugular vein, which was implicated in a tumour in the neck.

A similar case happened to Mirault of Angers, the internal jugular being divided to half its extent. A case occurred to Warren, in which the air entered by the subscapular vein, the coats of which were healthy, but in a state of tension in consequence of the position of the arm; and another, in which the same accident happened from the division of a small transverse branch of communication between the external and internal jugular, whilst in a state of tension. Mott, whilst removing a tumour of the parotid gland, opened the facial vein, which was in a state of tension in consequence of the position of the patient's head, when air was introduced. A case is related by Malgaigne in which the accident happened in consequence of the incomplete section of the external jugular vein, which was enveloped in a tumour that was being removed. M. Bégis also relates a case in which accident happened, in consequence of the puncture of the internal jugular whilst he was removing a tumour from the neck.

These cases, which are all that I have been able to meet with in which the condition of the wounded vein was particularised, show clearly what is the state of the vessel and of the surrounding parts that is most likely to favour the occurrence of the accident, and consequently what the surgeon should particularly guard against in the removal of tumours about the neck and shoulders; viz., incomplete division of the veins, and the employment of forcible traction on the diseased mass at the moment of using the scalpel. In removing tumours from the neck and shoulder, it is in many cases impossible to avoid drawing them forcibly upwards or forwards, in order to get at their deeper attachments; but if this be necessary the chest should, for reasons that will immediately be pointed out, be tightly compressed, so that no deep inspirations may be made at the moment that the knife is being used, or before a divided or wounded vein can be effectually secured.

Preventive Treatment.—When a patient is under the knife, the respirations are generally shallow and restrained, the breath being held, whilst every now and then there is a deep gasping inspiration; at which moment, if a vein be opened in which the pulse is perceptible, or which is canalised, air must necessarily be sucked in; and, as has already been said, in quantity and force proportioned to the depth of the inspiration. This, then, being the case, the mode of guarding against the introduction of air into the veins is obvious. The chest and abdomen should be so tightly bandaged with broad flannel rollers or lace napkins, as to prevent the deep gasping inspirations, and to keep the breathing as shallow as possible, consistently with the comfort of the patient. I have often found that the entrance of air into the veins of a dog could be arrested by forcibly compressing the chest of the animal, so as to confine the respiratory movements; but that, as soon as a deep inspiratory effort was made, the compression having been removed, a rush of air took place into the vessel. If, therefore, during an operation about the root of the neck or summit of the thorax, the chest be bandaged, as here recommended, the surgeon must be careful not to remove the compression until the operation is completed, and the wound dressed; for, if this precaution be not attended to, the patient will most probably, on the bandage being loosened, make a deep inspiration, and the air may be sucked in at the very moment when all appears safe.

Curative Treatment.—Different plans have been recommended by surgeons for the treatment of those cases in which air has already gained admittance into a vein; but, from the very fatal nature of this accident, it does not appear that much benefit has resulted from any of them: the recovery of the patient, in some of the cases, appearing to be rather due to the quantity of air that was introduced being insufficient to cause death, than to any

effort on the part of the surgeon. The two principal modes of treatment that have been recommended, consist in the *suction of the air from the right auricle*, and the employment of *compression of the chest*. Thus, Amussat and Blaudin advise us to introduce the pipe of a syringe, a female catheter, or a flexible tube, into the wounded vein, if it be large enough to admit the instrument, and if not, to open the right jugular, and pass it down into the auricle, and then to employ suction, so as to empty the heart of the mixture of blood and air. At the same time that this is being done, we are, say they, to compress the chest as forcibly as possible, so as to squeeze more of the air out of the heart. Magendie and Rochoux advise suction alone; and Clerly recommends us to be content with compression of the chest. Warren (of Boston) directs us to have recourse to *bleeding in the temporal artery*, to *tracheotomy*, or to *stimulants*, according to the condition of the patient.

The indications that present themselves in the treatment appear to me to be threefold:—

1. To keep up a due supply of blood to the brain.

2. To maintain the powers of the heart until the obstruction in the pulmonary capillaries can be overcome or removed.

3. To remove, if possible, the obstruction in the capillaries of the lungs.

We shall now see how far the means already mentioned, viz., suction, compression, &c., can fulfil these indications.

Suction would no doubt be highly advantageous if we could, by this or any other means, remove the air that has gained access to the heart, and thus prevent the pulmonic capillaries from being still farther obstructed. But, putting out of consideration the difficulty of finding the wounded vein; the still greater difficulty of introducing a suitable tube a sufficient distance into it; the danger of allowing the ingress of a fresh quantity of air, whilst opening the axilla of the incision in the vein so as to introduce the tube; and the risk there would be, if the patient recovered from the effects of the accident, of having phlebitis induced; putting aside all these circumstances, which appear to me to be most serious objections, it becomes a question, according to Amussat, who is one of the strongest advocates of this mode of practice, whether, by suction with a syringe, or even by the mouth, any material quantity of air can be removed. He says that, even when the tube is introduced into the right auricle, much more blood than air is constantly withdrawn. These considerations, then, should, I think, make the surgeon hesitate before having recourse to such a hazardous mode of procedure.

The next plan, that of *circular compression of the chest*, however valuable it may be in preventing the ingress of air, can, when that fluid has once been introduced into the veins, have no effect in removing it from the circulatory system. We cannot, by any compression that we may employ, squeeze the air out of the heart. But compression may not only be productive of no positive good, but may even occasion much mischief, by ~~compressing~~ still farther the already weakened respiratory movements, and ~~thus interfering~~ with the due aeration of the small quantity of blood that may yet be traversing the lungs.

Bleeding from the temporal artery can by no possibility be productive of any but an injurious effect, by diminishing the already too small quantity of blood in the arterial system. *Opening the right jugular vein* may, perhaps, to a certain extent, be serviceable, by unloading the right cavities of the heart, as Dr John Reed has shown it to be capable of doing; and it has been recommended by Dr. Cormack on this account. Lastly, *tracheotomy* cannot be of any particular service, as the arrest of the respiratory function is secondary, and not primary.

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CHAPTER XVI.

INJURIES OF NERVES, MUSCLES, AND TENDONS.

INJURIES OF NERVES.

Contusion.—Nerves are often contused; the injury producing a tingling sensation at their extremities, and pain at the part struck. These usually pass off in the course of a few minutes or hours; but, in certain conditions of the system, more especially in the hysterical temperament, they may last for a considerable period, and even give rise to neuralgia of a more or less permanent character.

Puncture.—If a nerve be punctured, unpleasant consequences sometimes result, more especially in delicate women. Thus, I have more than once seen a puncture of one of the digital branches of the ulnar nerve produce a kind of painful paralysis of its trunk, rendering the arm nearly useless. I have seen the same effects occur in the median nerve, from so slight a cause as the puncture of the finger by a needle. It occasionally happens in venesection at the bend of the arm, that a branch of the internal cutaneous nerve is pricked with the lancet, and that very persistent neuralgia occurs in consequence.

Division.—When a nerve is completely cut across, immediate paralysis of sense and motion occurs in all the parts supplied by it. Consequently, if the integrity of the nerve be essential to life, as of the pneumogastric, death must ensue. There are well marked loss of temperature, and modification of nutrition, in some cases of cut nerve. This is probably owing to the dilatation of the smaller arteries, and consequent slowness of circulation, which have been found in animals to follow the section of the nerve of a limb. Thus, in a patient who applied at the University College Hospital twenty-one weeks after the ulnar nerve had been accidentally divided, and who had paralysis of the parts supplied by it, I found the temperature between the ring and the little fingers of the injured side to be 9° Fahr. below that of the same spot on the other hand.

If a cut nerve be examined shortly after the injury, it will be found to have become slightly bulbous at the extremity, nervous matter having escaped from the neurilemma, and fibrine being thrown out around and between the two ends. Restoration of the continuity of the nerve evidently takes place, as is shown by the fact, that in the course of a few months its functions gradually become re-established in its lower part, the paralysis slowly disappearing. If, however, a portion of the nerve have been actually excised, there is no restoration of function, as was shown long ago by Haighton. Schwann and Haase have found the return of sensibility and motion in the lower part of the nerve to be owing to nerve-tubes forming in the uniting medium, and thus serving to establish the continuity of the nerve.

INJURIES OF MUSCLES AND TENDONS.

SPRAINS OR STRAINS of muscular parts, without rupture of fibre, are of very common occurrence, especially about the shoulders, hip, and loins, and are accompanied by much pain, stiffness, and inability to move the part. When they occur in rheumatic subjects, these injuries not uncommonly give

rise to severe and persistent symptoms; in some cases painful atrophy, rigidity, or local paralysis of the injured muscle being induced.

In the *Treatment* of these accidents, when recent, it will be found that kneading or rubbing the part with a stimulating embrocation, the application of dry cupping, or, if the pain be severe, the abstraction of a few ounces of blood by cupping, together with rest, is most efficient. If the injury occur in a rheumatic constitution it will be found useful to give colchicum and Dover's powder in the following form: \mathcal{R} Extracti Colchici Acetici, gr. j. Pulv. Ipecacuanhæ comp., gr. x; Extracti Colocyntidis comp., gr. iv.: fiant pil. ij. If the pain continue, the application of the "thermic hammer" is exceedingly serviceable; and if local paralysis or atrophy ensue, the use of the electro-magnetic apparatus will be beneficial.

Rupture.—Subcutaneous rupture of muscles and tendons not unfrequently occurs, not so much from any external violence, as from the contraction of the muscle rupturing its own substance. The rupture may occur at one of four points: in the muscular substance itself; at the line of junction between the muscle and tendon; through the tendon; and, lastly, at the point of insertion of the muscle or tendon into bone. Sedillot found that, in 21 cases, the rupture occurred at the point of origin of the tendon from the muscle 13 times; and in the remaining 8, the muscle itself was torn. It occasionally happens that the muscular sheath is ruptured, so that the belly of the muscle forms a kind of hernial protrusion through the aperture; or the tendon may be displaced by rupture of its sheath. This usually happens with the long head of the biceps, or the extensor tendons of the fingers.

These ruptures most commonly occur in middle-aged people, who have lost the elasticity of youth, though their physical strength be unimpaired. At the moment of the rupture taking place, the patient usually experiences a sudden shock, as if he had received a blow, and sometimes hears a snap. He becomes unable to use the injured limb, and at the part where the rupture has occurred finds a hollow or pit, produced by the retraction of the end of the torn muscle, which is contracted into a hard lump above this.

These accidents, though troublesome, are seldom serious. The tendo Achillis, the quadriceps extensor of the thigh, the triceps of the arm, the biceps, the deltoid, the rectus abdominis, are the tendons and muscles that most commonly give way, with the relative frequency of the order in which they are placed.

Union.—The mode of union of these injuries has been well described by Paget. When a tendon is cut or torn across, an ill-defined mass of nucleated blastema of a greyish-pink tint is effused into the cellular tissue and sheath, between the cut ends. About the fourth or fifth day this has become more defined, forming a distinct cord-like uniting mass between the ends of the tendon; in the course of two or three more days, this mass has become tough and filamentous; the tissue gradually perfects itself, until it closely resembles tendinous structure, though for some time it remains dull white and more cicatricial in appearance. The strength of this bond of union is marvellously great; Paget found that the tendo Achillis of a rabbit, six days after its division, required a weight of 20 lbs. to rupture it. In ten days the breaking weight was 56 lbs. Divided muscles unite in the same way as tendons, but less quickly, and by a fibrous bond.

Treatment.—The principle of treatment in these cases is extremely simple: it consists in relaxing the muscles by position, so as to approximate the divided ends; and maintaining the limb in this position for a sufficient length of time for proper union to take place. If relaxation be not attended to,

the uniting bond will be elongated and weak. Stiffness and weakness are often left for a length of time—for many months, indeed—after union has taken place. Warm sea-water douches, followed by methodical friction, will greatly tend to restore the suppleness of the parts.

When the tendo Achillis is ruptured, the best mode of treatment consists in the application of an apparatus formed of a dog-collar placed round the thigh above the knee, from which a cord is attached to a loop in the back of a slipper; by shortening this cord, the leg is bent on the thigh, and the foot extended, so that the muscles of the calf become completely relaxed. After this simple apparatus has been used for two or three weeks, the patient may be allowed to go about, wearing a high-heeled shoe for some weeks longer.

When partial rupture of one of the extensor muscles of the thigh takes place, the patient's limb must be kept for some little time in the same position as for fractured patella; and then he may be allowed to walk about with a leather splint behind the knee, so as to prevent flexion of this joint.

In ruptures of the muscles or tendons of the arm, a sling is all the apparatus required; but when these injuries occur to the deltoid, atony and atrophy are especially apt to result.

CHAPTER XVII.

INJURIES OF BONES AND JOINTS.

INJURIES OF BONES.

A bone may be bruised, bent, or fractured.

BREUING OF THE BONE AND PERIOSTEUM often occurs, and is usually of no great moment; but if severe, or happening in bad constitutions or in old people, it may give rise to serious consequences.

If the contusion be severe, the vitality of a layer, or even of the whole substance of the bone, may be destroyed, as happens sometimes from the grade or contusion of a bullet. Even a moderate contusion of a bone that is but thinly covered, as the shin, or elbow, may give rise to troublesome symptoms from inflammation of the periosteum. In old people, the contusion of a bone is frequently followed by its atrophy and shortening, as happens in the neck of the femur; and in strumous constitutions, serious disease of the bone may be attributed to this cause.

In the *Treatment* of bruised bone, leeches and fomentations are the most important means that we possess; the consequences will be considered when we come to speak of necrosis.

BENDING OF BONE may occur in two conditions, viz.: with or without fracture. Independently of fracture, it is most commonly met with in very young subjects, before the completion of ossification; the bone being healthy, but naturally soft, at this period of life. It occasionally takes place after the adult age, but is then the result of some structural change, by which the lateral firmness of the osseous tissue is diminished. The bending most commonly occurs in the long bones, especially the clavicle, the radius, and the femur, but sometimes is met with in the flat bones, or those of the skull, in which depression takes place from a blow without fracture having occurred. In many cases of bending both of long and of flat bones, there is partial fracture on the convex side.

The *Treatment* is simple: the surgeon gradually straightens the bone, by applying a splint on its concave side, towards which the bone is pressed by a bandage and a pad, applied upon its greatest convexity.

FRACTURES will be described at p. 214.

INJURIES OF JOINTS.

CONTUSIONS.—Joints are often *contused* by kicks, falls, or blows, so as to be severely injured, with much pain, and consecutive inflammation of the capsule, synovial membrane, or other structures entering into their formation. The treatment should be actively antiphlogistic, with complete rest of the part. In a later stage, an elastic bandage, cold douches, and friction, are useful.

In some cases the *bursa*, situated in the neighbourhood of a joint, is seriously bruised, and becomes inflamed in consequence; often giving rise to troublesome suppuration and some sloughing. When this takes place, free incision into the inflamed part, in addition to the ordinary antiphlogistic treatment, will afford speedy and effectual relief to the patient.

SPRAINS.—When a joint is twisted violently so that its ligaments are either much stretched or partially torn, though there be no displacement of the osseous surfaces, it is said to be *sprained*. These injuries are exceedingly painful and troublesome in their consequences. They most frequently occur to the wrists and ankle-joints. The pain attending them is very severe, and often of a sickening character, and the sprain is rapidly followed by swelling and inflammation of the joint and investing tissues, often very chronic and tedious. As the inflammation subsides, stiffness and pain in using the part continue for a considerable length of time, which, in some cases, give way to a kind of rigidity and wasting of the limb. In individuals of a rheumatic or gouty habit of body, the inflammation set up in the joint as a consequence of the strain is often of a most tedious and chronic character, and will only yield to appropriate constitutional treatment; and occasionally it happens that in strumous subjects destructive disease of the joint is induced.

Treatment—If the sprain be slight, rubbing the part with a stimulating embrocation, and giving it the support of a bandage, are all that need be done. But if it be at all severe, more active measures must be had recourse to. These must vary according to the condition of the joint when the surgeon sees the patient; but they are all conducted on the principles of securing perfect rest, and subduing inflammatory action. If the surgeon see the patient immediately on the occurrence of the accident, or before swelling to any great extent has occurred, the best method of treatment is that recommended by Mr. Hood, to strap up the joint very firmly with long strips of plaster, over which a starched bandage may be applied. This method of treatment, which comprises rest, perfect immobility, and compression of the joint, puts it into the best possible condition for the repair of the injured articular structures, and the prevention of consecutive inflammation. Should inflammation with much swelling have set in, this must be subdued by keeping the joint for several hours in cold water, or well moistened with an evaporating lotion, or wet by means of irrigation. Should this not check the inflammation, leeches may be freely applied; and, when the swelling has somewhat subsided, the joint should be supported with an elastic roller and plasters, a starched bandage, or leather splint. In the more advanced stages, when pain and stiffness alone are left, it should be well douches with cold water twice a day, and afterwards rubbed or kneaded with soap-liniment, until its usual strength and mobility are restored. Thus, however, very commonly does not occur in sprains of the knee and ankle for many

weeks; a degree of stiffness, combined with inflammation, being left until the stretched and lacerated ligaments have regained their normal condition.

WOUNDS OF JOINTS.—A joint is known to be wounded when synovia escapes from the aperture, or when the interior of the articulation is exposed. If there be any doubt as to the wound penetrating the synovial membrane, no means, by probing or otherwise, should be taken to ascertain this, as in this way the very occurrence that is to be dreaded may be induced by the surgeon. The fact of the wound penetrating into the interior of the joint will speedily be cleared up by the symptoms that supervene.

Symptoms and Effects.—The severity of the wound of a joint depends not only on the size of the articulation, but on the nature of the wound, and the age of the patient.

When a small joint, as that of one of the fingers, is opened, the injury may often be recovered from, without destruction of the articulation. When a large joint is opened, even by a small incised or punctured wound, there is great danger lest such extensive local mischief and constitutional disturbance ensue as to lead to the destruction of the articulation, with danger to the patient's life. When the wound is large, lacerated, or contused, with fracture of the articular ends of the bones, one or other of these consequences will certainly result. It is especially in adults that these unfavourable results ensue; in children, extensive injuries of large joints may heal favourably; though, if the child be of a strumous habit of body, destructive action is apt to be set up.

The source of danger in a wounded joint is the inflammation set up in the articulation (*Traumatic Arthritis*). A few hours after the infliction of the injury the joint swells, becomes hot and painful, and throbs. If, under proper treatment, resolution be effected, these inflammatory symptoms will gradually subside, leaving the articulation weak, tender, and stiff for some considerable time. Should, however, the inflammation continue, the pain increases, becoming tense and excessively severe. If the aperture be large, synovia freely escapes, which soon becomes mixed with pus. If it be small, but little more than a puncture, the joint swells and fills with purulent fluid, which will either escape through the original wound, or find an outlet for itself through a new situation. There are startings in the limb, with excessive pain in any attempt at moving it. The constitutional disturbance becomes very severe, the patient being occasionally carried off by the violence of the irritative fever. In other cases symptoms of purulent absorption come on, and death results from pyæmia.

If the patient survive this period of acute action, abscesses will form around and above the articulation, the discharge from which, as well as from the joint, induces irritative fever and hectic. Should this danger be passed through and the patient eventually survive, it will be with a partially diseased limb, the utility of which is greatly impaired.

The severity of the symptoms in the wound of a large joint is evidently dependent on the extent and depth of the synovial membrane which suppurates, wounds of gingivomol being hence more dangerous than those of osseous joints, and on the pus thus formed being pent up in the midst of loose and unyielding tissues, from which it has not a free exit. It is the accumulation of air into the joint that occasions the suppuration; for we find that, in the most extensive subcutaneous wounds and lacerations of joints, such as occur in dislocations and fractures, suppuration scarcely ever takes place. The presence of the air appears also to exercise an injurious influence upon the pus that is collected in the depths of the joint, causing it to become putrescent and acrid, and thus greatly increasing the local irritation.

It is also this retention of acrid and putrescent pus, in contact with a large inflamed surface, that gives rise to ataxic fever and pyemia, which so frequently prove fatal in these injuries. Of all wounds of joints, gun-shot injuries are necessarily the worst. In these the aperture cannot possibly be closed and united by the first intention; it and the track of the ball must suppurate. The bones are also usually splintered, and foreign bodies of various kinds are introduced into the articulation; hence the most extensive disorganising and fatal mischief commonly ensues.

Traumatic Arthritis differs from the destructive and disorganising idiopathic inflammations of joints in this: that when the inflammation occurs as the result of a wound, the synovial membrane is the part primarily affected; if the cartilages become involved, they are so secondarily; the articular ends of the bones not participating in the morbid action. When a joint is the seat of disorganising inflammation of an idiopathic character, the mischief usually commences in the osseous articular ends, or in the cartilage, the synovial membrane being often the last affected. In the traumatic form, the disease may be said to radiate from the centre of the joint; in the idiopathic, from the circumference.

In recent cases of traumatic arthritis we find the synovial membrane swollen, infiltrated, gelatinous-looking, and of a crimson colour; the contiguous or subjacent portions of cartilage are softened and partially eroded. Under the microscope, a disruption of the cartilage-cells may be observed, and the intervening substance is granular; these changes gradually cease in deeper sections of the cartilage, which will be found to present a healthy appearance. In the more advanced stages of the disease, when the joint has been suppurating perhaps for months, it will be found that the synovial membrane is deeply vascular in places, in other parts pulpy and infiltrated with, or replaced by, grayish or yellowish plastic matter. The cartilages are eroded in patches exposing the rough and injected surfaces of the articular extremity of the bone; where not eroded, they are pulpy and disorganised. Occasionally partial but unsuccessful attempts at bony union will have been set up between the opposite exposed osseous surfaces.

In the *Treatment* of wounded joints, the first point to be determined must be whether amputation or resection should be performed, or an attempt made to save the injured joint. If the joint be small, and the disorganisation of bones or soft parts not very great, there can be no doubt that we ought to attempt, and shall usually be able, to save it. But if it be one of the larger articulations, the line of practice must be determined by the extent of the injury to the soft parts, and the age and constitution of the patient. If the wound be but small and clean cut, no surgeon would be justified in having recourse to immediate amputation, even though it be the knee that is injured. But if the joint have been extensively laid open, with much contusion and laceration, complicated perhaps with dislocation, or with fracture and splintering of the bones, the case is different. Under these unfavourable circumstances, however, in the upper extremity, and even in the ankle, the limb may not unfrequently be saved. If the bones be comminuted, the removal of splinters and resection of the articular ends may advantageously be practised in many cases, more particularly if the patient be young and sound in constitution, and the soft parts not too extensively damaged. But if these be largely lacerated and widely contused, and the patient aged or broken in health, amputation is imperatively called for. This is more especially the case, when the knee is the articulation injured; extensive lacerations of this joint, more particularly complicated with dislocation or comminution of the bones, being cases for early amputation.

If it be determined to make an attempt at saving the joint, the principal point is, if possible, to close the wound by the first intention, and thus to prevent the occurrence of suppuration. If it be a puncture, or clean cut wound, this may occasionally be done by bringing its edges together and placing a piece of lint soaked in collodion upon it, or a strip of plaster washed over with resin varnish, the inflammatory action being subdued by continuous irrigation with cold water: no poulticing or warm fomentations should ever be allowed during this stage. Union may take place under the dressing; but in the majority of cases the inflammation that is set up in the joint causes so abundant a secretion of synovia, that it becomes loosened by the tension and outward pressure of the accumulated fluid which escapes from under it.

If suppuration have come on, free incisions, as recommended by Mr. Gay, should be made into the joint so as to procure an early outlet for the pus; the part must be well poulticed, and an attempt made at procuring anchylosis by the granulation and cohesion, through fibrous tissue, of the articular surfaces. By making free and early incisions into the joint after suppuration has once been set up, the dangers resulting from decomposition of the pus and its absorption into the system are in a great measure lessened, and the constitutional irritation produced by the tension of the parts is at once removed. The joint itself is not put into a worse condition by being more freely opened, for, when once suppuration has been set up in it, even to a limited extent, destruction of its tissues must ensue; and the most favourable termination that can be expected is the production of anchylosis. At the same time constitutional treatment must be employed, with a view of lessening febrile action and removing irritation. The administration of antimonials, with calomel and opium, is especially serviceable; but free purging and all other sources of irritation should be avoided.

If the case proceed favourably, the discharge will gradually lessen, and the constitutional disturbance subside. The joint must then be placed in such a position, that, when anchylosis results, the limb may be most serviceable to the patient.

If, however, as very frequently happens when the larger joints are wounded, the suppuration within the articulation, and the abscesses that form outside it, reduce the patient to a hectic state, secondary amputation speedily becomes inevitable.

When the wound in the joint is too extensive for union by the first intention to be effected, and yet it be thought proper to make an effort to save the limb, the continued dry application of ice, in India-rubber bags, and active antiphlogistic treatment, must be had recourse to, and free and early incisions made to relieve tension and let out matter, so as to lessen the intensity of the suppurative inflammation that will be set up. In the great majority of these cases, however, when the larger joints, of the lower extremity especially, are implicated, amputation will eventually be required; the instances of recovery under those circumstances being altogether exceptional, the patient seldom but infrequently sinking during the attempt at saving the limb.

WOUNDS OF INDIVIDUAL JOINTS.—To the preceding general principles I have little to add with respect to wounds of the individual joints.

The *Hip and Shoulder* are so deeply placed, and so well protected, that they can scarcely be wounded except as the result of gun-shot injury, the treatment of which condition has already been discussed.

Wound of the *Knee joint* is one of the most common and most severe of such injuries. When the result of gun-shot violence, it imperatively demands immediate amputation. When produced by a puncture or clean cut, the

wound must be closed, and cold irrigation and leeches may be employed advantageously. Should suppuration occur, the joint must be freely laid open by long incisions, and compound amputation will be required. The abscess will often form deeply in the thigh rather than in the joint itself; and in a very insidious manner. The limb swells up to the trochanters, becomes very tense, painful, hot, and oedematous, with great constitutional disturbance and irritative fever. But the joint may be but little swollen, and many days will often elapse before fluctuation can be felt in it, or in the thigh. It is this absence of swelling in the knee itself that may mislead an inexperienced practitioner. At length the abscess may approach the surface near the knee; and, on an incision being made, an immense quantity of pus is discharged. The abscess forms as a consequence of the escape of some of the irritating contents of the suppurating synovial membrane close upon the anterior surface of the femur; it creeps up and surrounds the bone under the deep muscles of the limb, which are separated from the bone, and may reach as high as the trochanters before it is detected. It is this depth in the limb at which the abscess is seated that occasions the remarkable difficulty in its detection, the violent constitutional disturbances it occasions, and its extreme danger. I have never seen abscess form amongst the muscles of the leg as a consequence of injuries of the knee-joint, unless the tibia had been fractured as well as the joint opened.

Wounds of the *Elbow* and *Ankle-joints*, when simple, as in punctures, usually admit of closure and of being healed, leaving a sufficiently useful and mobile articulation. When they are complicated with fracture of the neighbouring bones, the soft parts not being too extensively injured, resection of the injured articulations is the proper course; if there be much laceration of soft parts with comminution of the bones, amputation, especially in the case of the ankle, will be required.

Wounds of the *Wrist joint* are peculiarly dangerous, on account of the nature and complexity of the synovial membrane that enters into its conformation, should suppuration be set up. Some of the carpal bones may necrose, and thus amputation may be rendered imperative; or, if this be averted, a stiff and comparatively useless hand will be left.

Dislocations will be described at p. 285.

CHAPTER XVIII.

FRACTURES.

The management of fractures constitutes one of the commonest duties of the surgeon, and hence the consideration of all that relates to their nature and treatment is of the utmost importance.

CAUSES.—Fractures may occur from two causes—*external violence*, and *muscular action*. They are almost invariably the result of external violence, but the liability to their occurrence is more or less modified by certain predisposing circumstances.

Local Causes.—External violence may be applied in two ways: directly or indirectly.

The worst forms of fracture are occasioned by *direct external violence*, the blow crushing and splintering the bone, as by the passage of a heavy wheel or a gun-shot injury. When the bone is broken by direct violence, the

fracture is always at the seat of injury, and is often complicated with considerable mischief to the soft parts, the result of the same force that breaks the bone.

Indirect violence may break a bone in two ways. One that is more commonly talked of than seen is by *contrecoup*, in which, when a blow is inflicted on one part, the shock that is communicated expends its violence on the opposite point, where the fracture consequently occurs. This form of injury is chiefly met with in the head; and, although its occurrence has been denied, I cannot doubt it, as I have seen unequivocal instances of this kind of fracture.

In the next form of indirect violence occasioning fracture, the bone is broken by being snapped, as it were, between a resisting medium on one side, and the weight of the body on the other. Thus, a person jumping from a height and alighting on his feet, may break his legs by their being compressed between the weight of the body above and the ground below. The long bones are those which are most frequently fractured in this way; and the fracture occurs at the greatest convexity, or at their weakest point. When a person jumps from a carriage that is in motion, although the height of the fall be not great, yet its force is considerable, the body coming to the ground with the same velocity as that with which it was being carried onwards in the vehicle. Hence, fractures received in this way are usually severe, and often compound or comminuted.

Muscular action is not an unfrequent cause of fracture of those bones into which powerful muscles are inserted. This is especially the case with the patella and some of the bony prominences, such as the acromion, which are broken in the same way that a tendon is ruptured—by the violent contraction of the muscles attached to them tearing them asunder. It is not often that the long bones are so fractured; yet the humerus occasionally is, and it has happened that this bone has been broken by a person striking at, but not hitting another; or that the clavicle has been fractured by a rider giving his horse a back-handed blow. In these cases, however, muscular action may not have been the sole cause, the weight of the limb also tending to fracture the bone. Those bones that do not offer attachment to any powerful muscles, as the cranial, for instance, cannot be fractured in this way.

Predisposing Causes.—These are numerous and varied.

Some bones are especially liable to be broken in consequence of their *writing as points of support*. Thus, when a person falls upon the hand, the shock is transmitted from the wrist-joint through the radius, humerus, and clavicle, to the trunk; the radius and clavicle, being the weaker bones, are especially liable to be fractured under these circumstances. So again, the *position* of a bone, irrespectively of use or any other circumstance, may *predispose* it to fracture; the prominent position of the nasal bones, and the exposed situation of the acromion, render these parts peculiarly liable to this injury. The *shape* of some bones disposes them to fracture; thus, a long bone is necessarily more readily broken than a short and thick one; hence fractures of the tibia and femur from falls on the feet are more common than of the os calcis. *Certain parts of bone* are more commonly fractured than others. Those points especially into which powerful muscles are inserted, or that are in exposed situations, and hence liable to injury, or to receive the weight of the fallen body, are often broken. Hence the acromion, the olecranon, and the neck of the femur, are commonly fractured.

As exercises considerable influence, not only on the general occurrence

of fracture, but on the peculiar liability of certain bones. Though fractures may occur at all ages, even in intra-uterine life (Chaussier having dissected a foetus that had 113 fractures), yet bone, being elastic and cartilaginous in early age, is less readily broken than when it has become brittle and earthy, as in advanced life. In children, fractures most commonly occur in the shafts of the long bones; or at the point of junction between the shaft and epiphysis, where ossification has not as yet taken place. This separation of the epiphysis in children, the detachment as it were of the terminal points of ossification, is not unfrequently met with, and occurs chiefly at the lower ends of the humerus and femur, sometimes in the radius and other bones. As age advances, the compact tissue of the shaft becomes denser and harder, but the cancellous structure of the extremities more dilated, and looser; hence fracture of the neck of the femur is especially common in old people. In young persons also, the bone is usually simply broken transversely, but fractures taking place at a more advanced period of life generally assume an oblique direction, and become comminuted; so also they more commonly extend into joints than when occurring in early age.

Fracture termed *spontaneous* sometimes happens without any very direct cause, or under the influence of violence that would usually be insufficient to occasion it. This may happen in consequence of the texture of the bone being weakened or rendered more brittle by disease, such as *mollities* or *fragilitas ossium*, by the cancerous cachexy, by syphilis, by the presence of cancerous growths within the substance of the bone itself, or by the pressure upon, and absorption of it, by some neighbouring tumour. In other cases, again, it occurs without any apparent disease, local or constitutional. This usually happens as the result of the brittleness and weakening induced by age. I have known a gentleman little above fifty, apparently in perfect health, break his thigh with a loud snap whilst turning in bed. In these cases union rarely takes place, or not without much difficulty.

Sex necessarily influences the liability to fracture, men being more frequently exposed to the causes of this injury than women. In women, the bones that are most frequently fractured are the clavicle, the tibia, and the neck of the femur. In men, the shafts of the long bones, the cranium, and pelvis, are most frequently broken.

From statistical accounts it would appear that the right limbs are more frequently broken than the left, being more exposed to the causes of fracture. It has been supposed that the bones are more brittle in winter, and hence break more readily than at other seasons; but this is altogether a mistake, though fractures may be common at this period of the year, from falls being more frequent.

VARIETIES.—Fractures present important varieties as to their *Nature* and their *Direction*. The varieties as to nature depend upon the cause of the fracture, its seat, and the age of the patient.

Nature.—Fractures are divided into two great classes, according as they are unaccompanied or attended by an open wound leading down to the fracture—the first being called *Simple*, the second *Compound*. In the first class are included the *Simple Fracture*, where the bone is merely broken across, split, or fissured; the *Impacted*, where one fragment is wedged into another, the compact tissue being driven into the cancellous structure; and the *Comminuted*, where the bone is broken into several fragments.

When the soft parts covering the broken ends of bone are torn through, so that the fracture communicates by a wound with the surface of the body, it is said to be *Compound*. The fracture may be rendered compound in two ways; either by the same injury that breaks the bone lacerating the soft

parts, as when a bullet traverses a limb, and fractures the bone; or else by the protrusion of one of the extremities of the broken fragments through the integuments covering it. This necessarily most frequently happens when the fragments are sharp and pointed, and the coverings thin, as in fractures of the tibia, and may be occasioned either by muscular contraction driving the fragment through the skin, or by some incautious movement on the part of the patient forcing it through.

A fracture is said to be *Complicated* when the injury to the bone is conjoined with other circumstances which are perhaps of more importance than the mere fracture itself, the complication constituting often the most serious part of the injury, and influencing greatly the general result of the case. Thus, a fracture may be complicated with injury of an important internal organ, as of the brain, lungs, or bladder; the injury to the organ being inflicted by the projection against it of one of the broken fragments. So also, a fracture is not unfrequently complicated with the wound of one of the principal arteries of the part, as happens especially in the leg, where the tibia arteries, being in close contact with it, are often torn by the broken bone. In other cases, again, the fracture is associated with injury of a joint, or dislocation of it. Besides these varieties of fracture, it occasionally happens that a bone is only cracked, or partially broken. This especially occurs in the bending of bone in children, in which cases the fracture may be *Partial* or *Incomplete*, merely extending across the convexity of the curve made by the bone. This is sometimes called the "*green-stick*" fracture. *Intraosseal* fractures have been described; but this is an anatomical refinement of little practical value.

Direction.—The direction assumed by fractures varies greatly, and depends materially on the cause of the injury, as well as upon the bone that is fractured.

The line of fracture may run through a bone in three different directions: either *transversely*, *obliquely*, or *longitudinally* to its axis.

The *Transverse Fracture* is the simplest, and is seldom complicated with injury to the neighbouring parts. It chiefly occurs in children, and very frequently in the articular extremities or processes of bones; it unites readily, and is attended by but little displacement; it is most commonly the result of direct violence, but it may arise from muscular action, as in the case of the patella, which is usually broken in this way.

The *Oblique Fracture* commonly occurs from indirect violence; the breaking force being applied to the ends, and not across the shaft. It often runs a long way, more than half the distance of the shaft of a bone, and is more dangerous than the transverse, owing to the obliquity of the fracture causing the ends of the bone to be sharply pointed (Fig. 86, *a*), and thus frequently to puncture the skin, or to perforate an artery. It is tedious in its cure, owing to the fragments being less directly in apposition; hence, also, there is a greater liability to shortening of the limb; it is principally met with in the shafts of the long bones of adults and elderly people.

The *Longitudinal Fracture* consists of a splitting or fissuring of a bone in the direction of its axis (fig. 86, *b*). Longitudinal fracture, or splitting of bone, is not very common in civil practice; but in military practice it is of frequent occurrence, especially from the action of conical rifle-balls. In such cases, when the shaft is struck and



Fig. 86. Oblique and longitudinal fractures.

shattered, the splitting of the bone may extend widely in either direction—sometimes into the neighbouring joint, although, as Stromeyer has remarked, it usually stops short of this, terminating at the epiphysis. When produced by a blow, and sometimes not a very severe one, upon the articular end of a bone, this may be split and the joint thus opened.

SIGNS.—The signs of fracture, taken individually and singly, are all more or less equivocal, and may arise from other conditions of the part, being common to various injuries. It is rather by their simultaneous occurrence that we consider them as pathognomonic of the existence of a broken bone.

Amongst the more equivocal signs may be mentioned the occurrence of pain in the limb, which may be owing either to the laceration of the soft parts by the broken fragments, or to the general injury inflicted upon it. So also, the existence of increased or diminished swelling is observed in different cases of fracture; the augmented swelling being owing either to the extravasation of blood into the limb, which often takes place to a very considerable extent, even without the wound of any principal vessel; or to the approximation of the attachments of the muscles, by the shortening of the part. Diminished swelling, or flattening, occurs in some cases, in consequence of the weight of the limb drawing the part down, and thus lessening natural rotundity.

The more special and peculiar signs of fracture are three in number:

1. A Change in the Shape of the Limb; 2. Mobility in its Continuity; and 3. The existence of Grating between the Broken Ends of the Bone.

1. *The Change in the Shape of the Limb*, due to the displacement of portions of the broken bone, is perhaps the most important sign of fracture. it manifests itself by a want of correspondence between the osseous points on opposite sides of the body, by an increase or diminution of the natural curves of the limb, by angularity, shortening, or swelling.

In investigating the existence and extent of displacement in a case of fracture, the surgeon should always strip his patient, and compare the points of bone on the opposite sides of the body, and their relative situation to some fixed and easily distinguishable neighbouring prominences on the trunk or injured part of the limb. From this the measurements may be taken, by grasping the injured part and the corresponding portion of the healthy limb in each hand, and running the fingers lightly over the depressions and elevations, marking any difference that exists; or, if greater accuracy be required, measuring by means of a tape. In some cases the measurement must not be made between the trunk and the limb injured, or even from one extremity of the limb to the other, as shortening of the whole member might depend on other causes than fracture, such as wasting, disease of joints, or dislocation; when this is the case, the measurement must be taken between different points of the bone actually injured.

The displacement of a broken bone may be the direct result of the violence which occasions the fracture, the fragments being driven out of their position, as when a portion of the skull is beaten in; or it may result from the weight of the limb dragging downwards the lower fragment, as in a case of fractured acromion. In some cases, it is either occasioned, or greatly increased, by the direction of the fracture. Thus, in several cases of broken tibia which have been under my care, the line of fracture being oblique from above downwards, and from before backwards, I have found the upper end of the lower fragment project considerably forwards, sliding, as it were, along an inclined plane in the upper fragment; and in one of these cases, which I had an opportunity of dissecting after amputation, the direction of the fracture,

rather than muscular action, appeared to be the cause of displacement. In transverse fractures there is always but slight displacement.

Muscular contraction is, however, without doubt, the most active cause of displacement; hence, it has been found that in paralysed limbs which are fractured, there is but little deformity. The contraction of the muscles of the part approximating their points of attachment, owing to the support or resistance offered by the bone being removed, draws the most moveable fragment out of its normal position. The other causes that have just been mentioned, tend greatly to favour this kind of displacement; but in some cases, as in fractured patella, the displacement is entirely muscular, and in all fractures of the long bones it is chiefly due to muscular contraction.

The *Direction of the Displacement* is principally influenced by the direction of the fracture, the position of the limb, and muscular action; it may be angular, transverse, longitudinal, or rotatory.

In the *angular displacement* there is an increase of the natural curvature of the limb, the concavity of the angle being on the side of the most powerful muscles; thus, for example, in fracture of the thigh, the angle projects on the anterior and outer side of the limb, because the strongest muscles, being situated behind and to the inner side, tend, by their contraction, to approximate the fragments on that aspect. This displacement principally occurs in oblique and comminuted fractures.

The *transverse or lateral displacement* occurs when a bone is broken directly across, the fragments often hitching one against another, and so being, as it were, entangled together. In this case there is often but very little deformity.

In the *longitudinal displacement* there may be either shortening or elongation of the limb. When there is shortening, as most commonly happens in oblique fractures, it is dependent on muscular contraction, the broken ends of bone being brought together so as to overlap one another, or "riding." In other cases, the shortening may be owing to the impaction of one fragment in the other. In some cases there is preternatural separation of the fragments, the weight of the limb tending to drag the lower one downwards, or muscular contraction drawing the upper one away from it.

The *rotatory displacement* is owing to the contraction of particular sets of muscles twisting the lower fragment on its axis, as well as producing shortening of the limb. Thus, the external rotators in fractures of the neck of the thigh-bone, and the supinators in some fractures of the radius, have a tendency to twist or rotate the lower fragment in an outward direction.

2. The occurrence of preternatural *Mobility in the Continuity* of a bone cannot exist without fracture, and separation of the fragments from one another; hence, its presence may always be looked upon as an unequivocal sign of the bone being broken. It occasionally happens, however, that fracture may take place, and, owing to the impaction or wedging together of the fragments, mobility may not be perceived; hence its absence cannot in all cases be construed into a proof of the non-existence of fracture.

3. Another sign of much value in practice is the occurrence of *Crepitus*, or rather of the *Grating together of the Rough Surfaces of the Broken Bone*, which can be felt as well as heard on moving the limb. This grating can only occur when the fragments are moveable and in contact, and is especially perceptible when the rough ends of the broken bone are directly rubbed against one another, and not the smooth periosteal surfaces merely opposed or overlapping. It is not, however, an invariable accompaniment of fracture;

being absent in some cases, in which the fracture is firmly impacted, or when the fragments are widely separated. It must not be confounded with the crepitation that occurs in the limbs from other causes, as from emphysema, or from the effusion of serous fluid into the sheaths of the tendons, which gives rise to a peculiar crackling sensation, very different from the rough grating of a fracture.

It will thus be seen that each of these symptoms, taken individually, is more or less equivocal, and that it usually requires a combination of at least two of them to determine whether fracture exists. In ascertaining the existence of a fracture, the surgeon should make the necessary manipulations with the utmost gentleness, but yet effectually, so that no uncertainty may be allowed to remain as to the seat and nature of the injury, more especially when it occurs in the vicinity of a joint. The increased mobility may be ascertained by fixing the upper fragment, and rotating the lower portion of the limb; the grating by drawing down the lower fragment, so as to get the rough surfaces into apposition, and then grasping the limb at the seat of fracture with one hand, and rotating it gently with the other. The displacement must be ascertained by measuring the limb carefully in the way that has been directed, and by comparing the injured with the sound side.

DIAGNOSIS.—The diagnosis of the existence of an ordinary fracture is seldom attended by any material difficulty. The co-existence of displacement, of mobility, and of grating, will usually enable the surgeon at once and readily to pronounce with certainty its existence, when it is *simple*. When it is *compound*, there is frequently the additional evidence afforded by the protrusion of the end of one of the fragments; and if it be *comminuted* as well, the loose splinters will be readily felt.

There are, however, two conditions that render the existence of a simple fracture occasionally difficult. The first is, when only one of two or several bones is broken; the other, the impaction of the fragments.

When only one bone is broken in a situation where there are two or more, as in the leg, fore-arm, metacarpus or metatarsus, it may require very close and careful manipulation of the injured bone before the fracture can be detected. The surgeon must run his finger carefully over the most projecting ridge, feel for slight inequality, cedema at one part, and perhaps elicit the faintest occasional crepitus on fully and deeply moving the bone at the seat of suspected fracture.

In the case of impaction the diagnosis is even more difficult. Here no crepitus, and no preternatural mobility, can be found; but the surgeon must be led to his diagnosis by the recognition of the peculiar displacement and distortion which may be characteristic of the particular fracture, as, for instance, the deformity about the wrist in an impacted fracture of the lower end of the radius.

The difficulties of diagnosis in fracture of a single bone, or in an impacted fracture, are necessarily most seriously increased if there be much extravasation of blood into the limb; or, when the fracture is through an articulated end, if there should be much effusion into the neighbouring joint.

As has already been stated, the existence of a fracture where *compound*, and more particularly where *comminuted*, is usually readily determined. Here, the great mobility, the protrusion of fragments or splinters, and the ready crepitus, will seldom allow the surgeon to be at fault. Should any doubt exist, the introduction of the finger into the wound will enable the practitioner to determine with certainty, not only the existence, but the condition and extent of the fracture.

But with all the assistance that may thus be afforded, it is important to observe that the very existence of a bad compound and comminuted fracture may be unsuspected for many days, even though most careful examinations have been made with the view of ascertaining its presence. Of this important fact, which may have weighty bearings on medico-legal investigations, the following case is a good illustration. A young man was shot with a wooden ramrod through the left hand and shoulder, by the accidental explosion of his gun whilst he was loading it. The ramrod struck the humerus three inches below the shoulder-joint, full on its fore part. It was splintered against the bone, the fragments passing on each side, and mostly escaping through two apertures of exit posteriorly; some passing to the inner side between the large vessels and the bone, the others to the outer side between it and the deltoid. The patient was brought to the hospital, where I saw him a few hours after the injury, and, enlarging the wounds, extracted a number of splinters of the ramrod from around the bone. The limb was carefully examined, not only by me, but by several other surgeons present, to determine whether the bone had been fractured, or the joint injured. There was no sign of fracture detected—no shortening, no mobility, no crepitus, no inequality when the fingers were freely passed into the wounds. It was determined that no fracture existed, and the limb was accordingly laid on a pillow, and irrigation employed. Erysipelas set in, followed by extensive and deep suppuration in the limb. On examining this, with the view of giving a free exit to the discharges, eight days after the accident, displacement and crepitus were for the first time found, and it became evident that the humerus had sustained a comminuted fracture. The patient died of pyæmia; and after death the bone presented the appearances here given (Fig. 87), a long splinter having been detached in a longitudinal direction, a B, and the shaft broken across at C. Here, then, was not only a compound, but a comminuted fracture, detected for the first time a week after the infliction of the injury. It appeared probable that the blow of the ramrod had fractured the bone longitudinally, detaching the large splinter, which had become impacted; and that the shaft still held together by a narrow bridge of bone at C, which being broken across subsequently in moving the limb, now become heavy by inflammatory infiltration, led to the shortening of the limb and the lateral displacement of the fragments.

UNION OF FRACTURED BONE.—A fractured bone is ultimately united by being soldered together by the deposition of new bone around, within, and lastly between the broken fragments. In exceptional cases, as in fractures occurring within the capsule of a joint, and in those of the patella and the olecranon, union is effected by fibrous or filamentous tissue. In some instances that will hereafter be considered, owing to peculiar local or constitutional circumstances, new bone is not formed, but the uniting medium is of a fibrous character.

The new bone that constitutes the bond of union is termed *Callus*. In many cases a larger quantity of this is temporarily deposited than is permanently left. This temporary formation of bone goes by the name of the *provisional callus*. It is formed partly external to the fracture, encasing the broken ends, and partly in the medullary canal, so as to include the fragments between layers of new bone, and thus maintain them in contact. That which is permanently left, and which intervenes between the broken

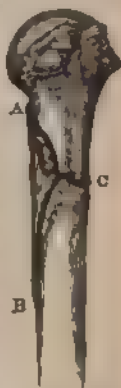


Fig. 87.—Comminuted Fracture of the Humerus.

ends, is called the *definitive callus*. The process of union varies somewhat in simple and in compound fractures.

Union of Simple Fractures.—The production of callus has been studied with much care by Haller, Duhamel, Bordenave and Hunter, by Dupuytren, Breschet, and Villerma, and more recently by Stanley and Paget. From the observations of these pathologists, it would appear that the union of a broken bone takes place through the medium of plastic matter, deposited by a process of adhesive inflammation set up in the injured bone itself, in its periosteum, and in the neighbouring soft parts; the lymph thus formed gradually undergoing development into osseous tissue. The whole process, indeed, is strictly analogous to that which takes place in the ordinary healing of a wound by adhesion and the development of the cicatricial tissue. The broken fragments are at first moveable, and surrounded by a considerable extravasation of blood. In the course of ten or fourteen days, this has ordinarily undergone absorption to a considerable extent; the periosteum and the medullary membrane in the vicinity of the fracture, the tissues around it, and the broken bone itself, become very vascular, and pour out a quantity of lymph between and around the fragments, as well as within the medullary canal, so that the fractured ends are ensheathed by a reddish gelatinous mass of a fusiform shape, thickest opposite the seat of injury. This gradually becomes more and more consolidated; and, in proportion as it becomes firmer, the mobility of the fragments lessens, and, the ends of the bone becoming smooth by the plastic deposit being adherent to and interposed between them, grating is less distinct. From the third to the fourth week the lymph has assumed a sufficient degree of firmness to keep the fragments in apposition, though the bone still yields readily at the seat of fracture. This lymph, which is poured out not only by the periosteum and bone, but by all the soft parts in the neighbourhood of the fracture, gradually undergoes ossification, the bony matter being first deposited in a granular manner, but in sufficient quantity by the sixth or eighth week to unite the fracture pretty firmly. The callus, which is at first soft and spongy, and differs from old bone in its microscopic as well as ordinary physical characters, gradually assimilates to old bone, both in hardness and in structure, osseous corpuscles and vascular laminated canals being formed in it; and it becomes smooth on the surface, being invested by a dense cellulo-fibrous periosteum, until, by the end of six or eight months, ossification is perfect. The last process in the consolidation of the fracture is the formation of new bone between the broken ends. This does not take place definitely until a considerable period after the ensheathing callus has been formed. This bone is deposited in the plastic matter effused between the fragments, which undergoes ossification in the same way as the external callus does. By the time that this intermediate or definitive callus is fully formed, that portion of the ensheathing or provisional callus which is not required for the preservation of the permanent integrity of the bone, has been gradually removed, or has moulded itself closely to the shape and condition in which it will ultimately remain, the medullary canal having again become free, and the ends of the fracture rounded off. In some cases the medullary cavity is not restored to its former condition for a considerable time, continuing to be partially occluded by a thin septum of callus.

According to Paget, the plastic matter that is effused around and between the bones undergoes ossification in various ways. Those fractures that ossify quickly do so most commonly through nucleated blastema, a fine closely granular ossific deposit taking place in the blastema, and becoming converted into the laminae of the cancellous tissue, the nuclei becoming

probably converted into bone-corpuscles. In other cases again, the nucleated cells of granulations and plastic effusions ossify by being transformed into bone. Then, again, the new bone may be formed by the plastic exudation passing, first of all, through the stages of fibrous tissue, of cartilage of the purest fetal form, or through fibro-cartilage.

In those fractures that are transverse, and that remain in steady apposition during ossification, and more especially if they are but thinly covered by soft parts, the union appears to take place directly and immediately between the opposed osseous surfaces; there being no appearance of those accessory deposits of bone that usually go by the name of "provisional callus." If, however, the fracture occur in a bone that is thickly invested by soft parts, masses of new bone will be thrown out around the fragments, evidently the result of deposition from the surrounding inflamed tissues, rather than from the injured periosteum or bone. The influence of the neighbouring soft parts in determining the deposits of new bone is well marked in the tibia. In a fracture of this bone we find that, at the anterior and inner part, which is thinly covered, union takes place directly between the broken ends: but at the posterior and outer side, where there is a thick envelopment of tissue, a large mass of provisional callus will often be found, filling up even the interosseous space. That neighbouring parts participate in the inflammation set up around the fracture, and throw out callus, is evident from what takes place occasionally when one of the bones of the forearm or leg is broken. Periostitis is then set up in the unbroken bone, opposite the seat of fracture, and osseous matter is sometimes deposited by it. We have specimens illustrating this point in the University College Museum.

In fractures occurring in young infants, the quantity of callus thrown out is proportionately very great. This may perhaps be owing to the difficulty of maintaining such fractures in steady apposition.

If the fracture be not well reduced, the ends not being in proper apposition, or if it be comminuted, it will commonly be found that masses of new bone are deposited as buttresses or supports; or, enveloping the splinters, consolidate them in this way with the rest of the shaft. So, also, if the fractured bones are not kept sufficiently quiet during treatment, the neighbouring parts become irritated, and provisional callus is formed. Hence, as Paget has remarked, we commonly find this deposit in fractures of the ribs, which are kept in constant motion by the respiratory actions. In unimpacted fractures there is, from the perfect apposition of the surfaces, but little callus formed.

From all this, I think it clear that in simple fractures the provisional callus is deposited principally by the surrounding soft tissues, and also, to a certain extent, by the periosteum and medullary canal, its quantity being dependent on the amount of irritation set up in these textures. The definitive callus, on the other hand, is directly and immediately formed by the vessels of the fractured bone itself, and the comparative want of vascular supply to this tissue may account for the slowness of its formation.

Union of Compound Fractures.—The difference between the union of a simple and of a compound fracture is the same as that between the healing of a subcutaneous and an open wound. In the one case, the healing process takes place without any sensible local disturbance or constitutional derangement; in the other, it is accompanied by local inflammation and suppuration, and by corresponding febrile reaction. In the one case, there is no exciting cause for the development of secondary diseases; in the other, the local mischief is extremely apt to generate these in their worst forms, of erysipelas,

inflammation of the absorbents or veins, and pyæmia. In compound fractures, union takes place by the ends of the bone, which lie bathed in the pus of the wound, granulating and throwing out plastic matter, which becomes directly converted into bone. There is in many cases but little provisional callus; but in most instances a large quantity of accessory osseous deposit takes place, more particularly if the displacement be considerable. The union of these fractures precisely resembles that of a wound in the soft structures—by granulation, or “the second intention”; the only difference being that the granulations which are thrown out by the bone and periosteum develop into new osseous tissues either directly or through the medium of an antecedent fibroid transformation. This process necessarily occupies a much longer time than that which is necessary for the union of simple fractures, consolidation not being effected for three or four months, and often being very considerably retarded beyond this by the separation of necrosed bone, the formation of abscesses, &c. Rokitsansky is of opinion, that superficial exfoliation of that layer of bone which is bathed by the pus takes place, and that it is after this is separated that the granulations spring up, in which the new bone is deposited. I think that it admits of very considerable doubt whether this process of necrosis goes on in all cases of compound fracture.

Union of fractures, like all other vital actions, takes place more readily and much more quickly in the early periods of life than at a more advanced age, and is always more speedily accomplished in the upper than in the lower extremities.

TREATMENT OF SIMPLE FRACTURES.—In conducting the treatment of a fracture, the object of the surgeon should be not only to obtain a sound and strong limb, but one that presents as little deformity and trace of former injury as possible. In order to accomplish this, the broken ends of the bone must be brought into as perfect apposition as possible, the recurrence of displacement must be prevented, and the local and constitutional condition of the patient properly attended to.

When the surgeon is called to a person who has met with a fracture, if it be a severe one of the upper extremity, or of any kind of the lower limbs, he must see that the bed, on which the patient may have to remain for some weeks, is properly prepared, by being made hard, flat, and firm, and, if possible, covered with a horse-hair mattress. The surgeon must then superintend the removal of the patient's clothes, having them ripped along the seams, so that they may be taken off with as little disturbance as possible to the injured part. He next proceeds to the examination of the broken limb, using every possible gentleness consistent with acquiring a proper knowledge of the fracture. After he has satisfied himself upon this point, the limb should be laid upon a soft pillow, until any necessary apparatus has been prepared.

Reduction.—When all has been got ready, the reduction of the fracture, or the bringing the fragments into proper apposition, must be proceeded with. This should, if possible, always be done *at once*, not only lest any displacement that exists may continue permanently—the muscles, after a few days, becoming shortened, rigid, and unyielding, not allowing reduction to be effected without the employment of much force—but also with the view of preventing irritation and mischief to the limb, by the projection of the sharp and jagged ends of bone into the soft structures. A great deal of time is often lost, and very unnecessary pain inflicted upon the patient, and great irritation set up in the limb, by the surgeon leaving the fracture unreduced, *on a pillow for several days*, and applying evaporating lotions to take down

the swelling, and threatened inflammation, which are a consequence of the non-reduction of the broken bone. By early reduction we may sometimes prevent a sharp fragment from perforating the skin, and thus rendering a simple fracture compound, or lacerating muscles and nerves, inducing perhaps traumatic delirium, and certainly undue local inflammatory and spasmodic action.

The great cause of displacement in fractures has already been stated to be muscular contraction; hence, in effecting reduction of a fracture and in removing the displacement, our principal obstacle is the action of the muscles of the part. This must and always may be counteracted, by properly relaxing them by position; so soon as this is done, the bony fragments will naturally fall into place: but no amount of extension and of counter-extension can get these into position, and much less retain them there, unless all muscular influence be removed.

In ordinary fractures, no force is necessary or should ever be employed for accomplishing this: but attention to the attachment of the muscles of the limb and proper relaxation of them is all that is required. In impacted fractures it is occasionally necessary to use force in order to disentangle the fragments, but this is the only form of fracture in which its employment is justifiable. In effecting the reduction, not only must the length of the limb be restored, but its natural curves must not be obliterated by making it too straight.

Prevention of Return of Displacement.—After the reduction has been accomplished, means must be taken to prevent the return of the displacement, for, if the parts be left to themselves, muscular action, or the involuntary movement of the patient, will be certain to bring about a return of the faulty position. In many cases it is exceedingly difficult to preserve the fracture undisplaced for the first few days after its occurrence, in consequence of spasmodic movement of the muscles of the limb, or of restlessness on the part of the patient. About this, however, the surgeon need not be anxious, as no union takes place for the first week or ten days; at the expiration of that time the muscles will have probably lost their irritability, and the patient have become accustomed to his position, so that with a little patience, or by varying the apparatus and the position of the limb, good apposition may be maintained.

The return of displacement is prevented, and the proper shape and length of the limb are maintained, by means of bandages, splints, and special apparatus of various kinds. In applying these, care should be taken not to exert any undue pressure on or forcible extension of the limb. Pads and compresses of all kinds should, if possible, be avoided; they do no good that cannot be effected by proper position, and often occasion serious mischief by inducing sloughing of the integuments, over which they are applied. Screw-apparatus has been invented with the view of forcing fragments into proper position, but nothing can be more unsurgical and unscientific than such barbarous contrivances as these.

In cases in which there is much tendency to a return of the displacement, it has been recommended to divide the tendons of some of the stronger muscles inserted into the lower fragment. This, however, can very rarely be necessary, and in those cases in which I have done it, or seen it done, no material benefit has resulted.

The bandages used for fractures should be the ordinary grey calico rollers, about three finger breadths in width, and of sufficient length. In applying them, especial care must be taken that the turns press evenly upon every part, and that the bandage be not applied too tightly in the first instance.

The bandage should be applied under the skin, more particularly at the fracture of *pectus*, not care being taken that the skin be not torn, or its pressure altered in any material degree, after bandages have been applied. A bandage under the skin is not only tedious, but highly dangerous, by inducing one of strangulation. No bandage should be applied to the part of the *limb* that is the seat of fracture. The part where the fracture may advantageously be bandaged, is either *inferior* or *superior*. Thus, in fracture of the humerus, the fingers and forearm may be bandaged with this view, but portions of the *upper* should be brought above the elbow. This point of practice I consider most important, as the application of a bandage to the immediate seat of fracture not only causes great pain and disturbs more of the limb, but danger of gangrene. The limb should be examined from time to time during the treatment, and, if the patient complains of any pain or numbness, or if the extremity part look blue and feel cold, the bandage must be immediately removed; for, though the apparatus have not been applied tightly, swelling of the limb may come on from various causes, to such an extent as to produce strangulation and consequent gangrene of it, as I have seen happen in at least three instances, the limb requiring amputation in each case (Fig. 82). It is remarkable, that the whole of a limb will fall into a state of gangrene under these circumstances, with but little pain, and often with very slight constitutional disturbance, the parts having their sensibility diminished by the gradual congestion and infiltration of the tissues. When such an unfortunate accident happens, immediate amputation must be had recourse to. Before applying the apparatus in a case of fracture, and as often as it is taken off, it is a good plan to sponge the limb with warm soap and water, which prevents the itching that otherwise occurs and is sometimes very troublesome.

The *Splints* that are used in cases of fracture are of various kinds. Tin, wood, leather, and gutta-percha, are the materials usually employed. For some kinds of fracture, special, and often very complicated apparatus, is very generally used; but the surgeon should never confine himself to one material, or one exclusive mode of treating these injuries, as in different cases special advantages may be obtained from different kinds of splints. Wood and tin are principally employed in the lower extremity, where great strength is required to counteract the weight of the limb and the action of its muscles; and care must be taken to pad very thoroughly splints made of these materials. Leather, gutta-percha, and pasteboard, are more commonly useful in fractures of the upper extremity, though they may not unfrequently be employed with advantage in the lower limbs. In applying them, a pattern should first be cut out in brown paper, of the proper size and shape; the material must then be softened by being well soaked in hot water, and moulded on to the part whilst soft; so soon as it has taken the proper shape, it should, if leather or gutta-percha be used, be hardened by being plunged into cold vinegar and water; the pasteboard must be allowed to dry of itself. Its edges may then be pared and rounded, and its interior lined with wash leather or lint. These splints have the advantage of great durability, obscurity, and lightness. The material of which the splint is composed is of less consequence than its mode of application. There are two points that require special attention in this respect:—1, That the splint be sufficiently broad to extend to the exterior of the limb, and not to press into it; and 2, that it embrace securely and fix steadily the two joints connected with the fractured bone, if the thigh, the hip and knee, if the leg, the knee and ankle. From want of attention to this point of practice much trouble is often occasioned in keeping the fragments in steady apposition,

and much deformity will often result. It is impossible to keep the fragments perfectly immobile, and in close and accurate apposition, unless this very important point is attended to.

Special Apparatus should be employed as little as possible in the treatment of fractures. It is scarcely ever necessary in simple fracture, and is far more cumbersome and costly than the means above indicated, which are all that can be required. I have no hesitation in saying, that a surgeon of ordinary ingenuity and mechanical skill may be fully prepared to treat successfully every fracture to which he can be called, by having at hand a smooth deal plank half an inch in thickness, and a sheet of gutta-percha, untanned sole-leather, or pasteboard, to cut into splints as required.

To these simple means the *Starched Bandage* is an invaluable addition. Although various plans for stiffening and fixing the bandages in cases of fracture, by smearing them with white of eggs, with gum, plaster of Paris, &c., have been employed at various times, it is only of late years that the full value of the starched bandage has been recognised by surgeons, chiefly through the practice and writings of Baron Scutini.

The advantages of the starched bandage in the treatment of fractures, as well as in many other injuries and diseases, consist in its taking the shape of the limb accurately and readily, and maintaining it by its solidity; in its being light, inexpensive, and easily applied, with materials that are always at hand. It secures complete immobility of the limb in the position in which it lies. The joints in the neighbourhood of the fractured bone are securely fixed, and the perfect adaptation or moulding of the apparatus to the inequalities of the limb prevents all movement. Thus it becomes a powerful and efficient extending apparatus, maintaining accurately not only the length, but the normal curves of the limb. From its lightness, it possesses the very great and peculiar advantage in fractures of the lower extremity, of allowing the patient to remain up and to move about upon crutches during nearly the whole of the treatment, and thus, by rendering confinement to bed unnecessary, preventing the tendency to those injurious consequences that often result from these injuries; and, by enabling the patient to keep up his health and strength by open-air exercise, it facilitates the consolidation of the fracture. In addition to this, the patient will often be able to carry on his business during treatment. By employing the starched bandage in the way that will be immediately pointed out, I scarcely ever find it necessary to keep patients in bed with simple fractures of the thigh for more than six or seven, or of the leg for more than three or four days, thus saving much of the tediousness and danger of the treatment.

The following is the mode of applying this apparatus that is adopted at the University College Hospital, and which will be found to answer well. The whole limb is enveloped in a layer of cotton-wadding, which is thickly laid along and over the osseous prominences; over this should be laid splints of three-and-a-half ounce pasteboard soaked in thin starch, properly shaped to fit the limb, extending beyond and fixing securely the two joints above and below the fracture, the hip and knee when the thigh is broken; the knee and ankle when the leg is fractured. The pasteboard should be soft, not dried, and be double, and torn down, not cut, as in this way the edges are not left sharp. If much strength be not required, as in children, or in some fractures of the upper extremity, a few slips of brown paper, well starched, may be substituted for the pasteboard. A bandage saturated with thick starch must now be firmly applied; and lastly, this is to be covered by another dry roller, the inner sides of the turns of which may be starched as it is laid on. I always take especial care not to apply any roller or bandage

directly to the fractured part under the splints, and always to include in the starched apparatus the two joints that are connected with the broken bone, so

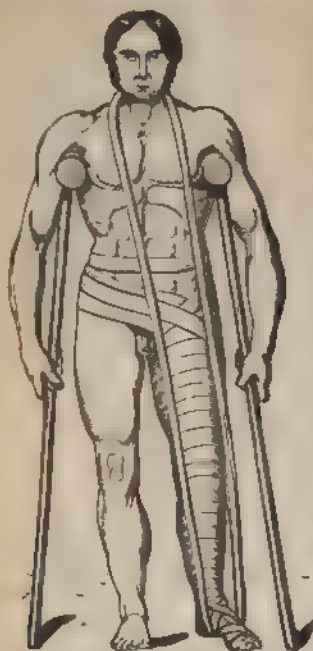


Fig. 88.—Starched Bandage applied.

that complete immobility of the fragments may be secured. During the application of this apparatus, extension must be kept up by an assistant, so as to hold the fracture in position; and, until the starch is thoroughly dried, which usually takes from thirty to fifty hours, a temporary wooden splint may be applied to the limb, so as to keep it to its proper length and shape. The drying of the starch may, if necessary, be hastened by the application of hot sand-bags to the apparatus. After the bandages have become quite dry, the temporary splints must be removed, and the patient may then be allowed to move about on crutches, taking care, of course, to keep the injured limb well slung up, and not to bear upon it, or to jar it against the ground (Fig. 88). In the course of about three or four days after its application, the apparatus will usually be found to have loosened somewhat, the limb appearing to shrink within it. Under these circumstances it becomes necessary to cut it up with a pair of Seutin's pliers, such as are represented in Fig. 89. This section must



Fig. 89.—Seutin's Pliers.

be made along the more muscular part of the limb, so that the skin covering the bones be not injured, as represented in Fig. 90; and, after paring the edges of the splint, it must be re-applied by means of tapes or a roller. It will always be found advantageous to adopt the practice of M. Burggraefe, of Ghent, and to envelop the whole limb

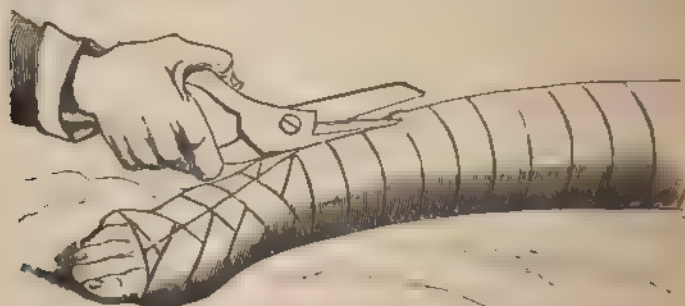


Fig. 90.—Application of Seutin's Pliers to Starched Bandage in a thick layer of cotton-wadding before applying the starched bandage.

this, being elastic, accommodates itself to the diminution in the size of the limb, and thus keeps up more equable pressure. Indeed, of late I have invariably adopted this practice, and found much advantage from it, dispensing with any dry roller next the skin, which there is always pain and difficulty in applying, and from which there is danger of constriction or of abrasion. In trimming the edges of the splint, it should not be removed from the limb; and after this has been done, the apparatus must be fixed together again with tapes or a roller. If the fracture be compound, a trap may be cut in the apparatus opposite the seat of injury, through which the wound may be dressed (Fig. 91).

Although fully recognising the great advantages to be obtained by treating fractures on this plan, and employing the starched bandage in almost every case that came under my care, I did not at first think that it was a safe practice to have recourse to it during the early stages of fracture; until, indeed, the swelling of the limb had begun to subside. I therefore never applied it until the sixth, or eighth, or tenth day, keeping the limb properly reduced upon a splint, very lightly bandaged, wet with cold evaporating lotions until this time; fearing that, if the bandage were applied at too early a period, the inflammatory tumescence of the limb might give rise to a slow strangulation of it under the apparatus.

During many years, however, I have followed Seutin's plan in some hundreds of fractures of all kinds, putting the limb up in the starched apparatus immediately after the reduction of the fracture, and have found the practice an extremely successful one, even in fractures of the thigh; so much so, that at the hospital I now rarely use any other plan of treatment; and indeed, the more experience I have of it, the more satisfied am I with the results obtainable by it. I find that the moderate pressure of the bandages, aided probably by the great evaporation which goes on during the drying of so extensive and thick a mass of wet starch, and which produces a distinct sensation of cold in the limb, takes down the extravasation most effectually, and enables the patient usually to leave his bed about the third day after the injury, when the fracture is in the leg or ankle, and about the sixth when it is the thigh that is broken; so that we now treat all patients with simple fractures of the leg, and many with fractures of the thigh, especially children, as out patients.

From no other means of treatment have I seen such satisfactory results in cases of fractured thigh, as from the starched apparatus; patients having frequently been cured without any shortening whatever, with the preservation of the natural curve of the bone, and without confinement to bed after the first week.

In compound fractures also of the legs, and even of the thigh, I have obtained most satisfactory results from this means. In compound fractures of the leg, I have seen the patient walking about on crutches as early as the tenth or fourteenth day, the limb being securely put up in starch; and have more frequently succeeded in getting union of the wound, and consequently



FIG. 91.—Starched Bandage.
Trap left for Dressing Wound.

in converting the compound into a simple fracture, by putting up the limb in this apparatus than in any other.

The *Plaster of Paris Bandage* may sometimes be advantageously used as a substitute for the starched apparatus. It may be applied in the following way. A bandage of coarse soft muslin must have dry plaster of Paris thoroughly rubbed into its meshes: it is then to be rolled up, and some cold water poured upon each end of it so as to moisten it through. A dry roller having been previously applied to the limb, the wetted plaster bandage must be smoothly rolled up it, the surgeon taking care that no reverses are made. In order to avoid these, it may be applied in a spiral or figure-of-8 manner over the more unequal parts. Slips of the plaster bandage should also be laid on where additional strength is required, and the whole well wetted from time to time during the application. It hardens in the course of a few minutes, and, as it dries, forms a solid, hard, and light casing to the limb, affording excellent support to the fracture. The plaster bandage possesses the advantage over the starched apparatus of being lighter, and especially of drying and hardening very quickly—qualities which render it invaluable in cases in which it is necessary to carry patients any distance immediately after the setting of the fracture.

In the treatment of simple fractures the following are the chief points that require attention:—

1. To effect reduction at once, and with as little disturbance of the limb as possible.
2. Not to apply any roller to the part of the limb in which the fracture is situated, nor under the splints.
3. To pad or wad the splints thickly.
4. To include and fix the two joints connected with the injured bone in the apparatus.
5. To disturb the apparatus as seldom as possible.

6. To use pasteboard splints, protected by cotton wadding, and supported by the starched bandage, in preference to any more special form of apparatus.

ACCIDENTS DURING TREATMENT—Various accidents are liable to occur during the treatment of a fracture; some of these are of a general, others of a special character. Amongst the more general accidents, Tetanus, Traumatic Delirium, and Erysipelas, may be mentioned as the most common. Amongst the more special, the occurrence of Spasm of the Muscles of the Limb, Abscess, Oedema, Gangrene, and a tendency to Pulmonary and Cerebral Congestion, are those that have most to be guarded against.

In order to prevent the occurrence of these conditions, the general health must be carefully attended to; the bowels being kept open, the room well ventilated, nourishing diet allowed, and long confinement to bed avoided by the use of the starched bandage.

The treatment of the more general accidents presents nothing that need detain us here; but those that are more special and peculiar to fractures, require consideration.

Spasm of the Muscles of the Limb, owing to the irritation produced by the fragments, is often very severe so long as the fracture is left unreduced; the sharp end of the broken bone puncturing and irritating the surrounding muscles. It is best remedied by reduction, and the maintenance of the fracture in proper position by moderate pressure with a bandage. If the spasm be dependent upon nervous causes, full doses of opium will not unfrequently afford relief. In some cases, it is of a permanent character, producing considerable displacement of the fragments. In these circumstances, division of the tendons has been recommended; but this practice

appears to be an unnecessarily severe one, and may certainly most commonly be avoided by attention to the other plans of treatment which have been suggested.

Considerable Extravasation of Blood is frequently met with in cases of simple fracture, causing great swelling and tension of the limb. By the continuous application of cold evaporating lotions, the collection is usually readily absorbed; and the surgeon should never be tempted by any feeling of fluff or of fluctuation to open it, as he would thereby infallibly convert the simple into a compound fracture, and give rise to extensive ill-conditioned suppuration. In some of the cases of extensive extravasation, the limb appears to relieve itself of the serous portion of the blood effused, by the formation of large bulke or blebs, which may be punctured, or else allowed to burst and subside, without any material inconvenience. This extravasation very rarely, indeed, runs into abscess; if it do, it must of course be opened, and treated upon ordinary principles. If deeply effused it may lead to gangrene, by the constriction and compression which it exercises on the muscles of the limb.

Edema and Gangrene of the limb (Fig. 92) may occur in two ways; either as the result of tight bandaging; or also of the swelling of the limb conse-



Fig. 92.—Gangrene from Tight Bandaging.

quent upon extravasation of blood, or of inflammatory infiltration causing strangulation within a bandage that has been at first but lightly applied. It is almost invariably the consequence of the pernicious and dangerous practice of applying a bandage *directly* to the limb under the apparatus in cases of fracture. I have never known gangrene occur after fracture, except where this has been done. If the splints be well wadded, and no bandage be put on under them, it is almost impossible that an undue or dangerous amount of constriction can be exercised on the limb, so as to interrupt the circulation through it. I believe that this accident would rarely, if ever, occur, if the surgeon were to avoid the direct application of a bandage to the limb, however lightly, in fractures, more particularly in children. The danger of strangulation is especially great if, as happened in the case from which the accompanying cut is taken, the limb be bandaged whilst straight, and then flexed, as the bandage will then cut in deeply at the flexure of the joint, and certainly destroy the vitality of the part, if not of the whole limb. Even if no *direct* bandage have been applied, the apparatus should at once be removed, and the limb examined, whenever the patient complains, even of slight uneasiness; or, indeed, if any appearance of congestion, such as blueness, coldness, oedema, or vesications of the fingers and toes, show themselves. If it be left on beyond this, gangrene will probably set in, slow strangulation going on under the bandages without much, if any, pain. Too much importance must not be attached to the mere appearance of vesications. They will often occur of very large size, as has already

been stated, as a consequence of the raising of the cuticle by the transuded serum of extravasated blood. It is only when associated with coldness of the limb, a dusky purple hue, and a putrescent odour, that they are indicative of gangrenous action. An excellent plan of judging of the activity of the circulation in a fractured limb after it has been put up, is to leave the ends of the fingers or toes uncovered by the bandage; when, by pressing upon one of the nails, the freedom of the circulation may be ascertained by noticing the rapidity with which the blood returns under it. Should gangrene unfortunately have occurred as the result of tight bandaging, or in consequence of the surgeon neglecting to examine the limb, and thus allowing slow strangulation to set in, there will be no resource but to amputate above the line of demarcation.

In fractures occurring in old people, there is a great tendency to *Pulmonary and Cerebral Congestion*, partly from determination of blood, and partly as a consequence of the long confinement required; these fractures commonly prove fatal in this way. The use of the starched bandage, by enabling the patient to move about, is the most effectual preventive of these accidents.

COMPLICATED FRACTURES.—Fractures may be complicated with various important local conditions. Thus the *extravasation of blood* into the limb may arise from a wound of some large vessel, and this may go on to so great an extent as to occasion strangulation of the tissues; if not checked by position and cold applications, it may give rise to gangrene, and demand amputation. In other cases, again, the soft parts in the vicinity of the fracture may be contused to such a degree that they rapidly run into slough, thus rendering it compound; or a wound may exist, not communicating with the broken bone, but requiring much modification of treatment, and special adaptation of apparatus.

One of the most serious complications of a simple fracture is undoubtedly the *rupture of the main artery* of the limb opposite the seat of fracture, or its wound by one of the fragments of broken bone. This accident chiefly occurs in fractures of the lower part of the femur or upper part of the tibia; the popliteal in one case, and the posterior tibial in the other, being the vessel wounded. The symptoms consist in the rapid formation of a uniform elastic tense swelling of the limb, with obscure pulsation or thrill, opposite the seat of injury, and cessation of pulsation in the arteries at the ankle, with coldness and numbness of the foot and lower part of the leg. If the posterior tibial be the vessel injured, the circulation in the arteries of the foot may return after a day or two, and the coldness and numbness may lessen. If it be the popliteal that is injured, no such amelioration will take place, but the diffused aneurism in the ham will increase, the circulation will become more and more impeded, and gangrene will result.

What is the treatment of such a case as this? The surgeon has three alternatives.

1. The case may be treated as one of open arterial wound, the tumour laid open, and the injured vessel ligatured at the seat of wound. The objections to this treatment are, that a large cavity is opened, which must suppurate, and will probably slough; that the fracture is rendered a compound one of the worst kind; and that the securing the artery is, under any circumstances, in the highest degree difficult, and indeed uncertain, entailing such an amount of disturbance of the soft parts as seriously to imperil the vitality of the limb.

2. The circulation through the femoral artery may be arrested by *compression or ligature* of the vessel. I am not aware that compression has ever been tried in a case of diffused traumatic aneurism; but there can be

no reason why the effects of pressure upon the artery, by means of Carte's or some other proper compressor, should not be tried before proceeding to more severe measures. Should it not succeed, the artery may be tied in Scarpa's triangle. But this should only be done in those cases in which, notwithstanding the existence of diffused traumatic aneurism in the ham, the pulsation has returned in the arteries of the foot, and the warmth and sensibility of the member have been in part at least restored. If these evidences of a return of circulation through the anterior tibial have not taken place, it will be worse than useless to ligature the femoral, as gangrene must inevitably ensue.

3. Amputation of the thigh may be performed. This severe measure need not be had recourse to at once. The surgeon may wait a day or two, and watch the progress of events. If he find that there is no sign of restoration of pulsation in the arteries of the foot, that the coldness and numbness of the limb continue to increase, and, in fact, that gangrene is impending, then the sooner he amputates the better for the patient's safety. So, also, if the artery have been tied, and gangrene result, the removal of the limb ought at once to be practised.

To sum up, I would advise, in a case of diffused traumatic aneurism arising from and complicating a simple fracture of the lower extremity : 1. Not to open the tumour and search for the artery at the seat of wound ; 2. To compress or ligature the femoral, if pulsation have returned or continue in the arteries of the foot ; but, should such pulsation not have returned within two or three days, should gangrene be imminent, or actually have set in, or should the artery have been ligatured, and mortification have ensued, to amputate high in the thigh without further delay. It will thus be seen that, in a diffused traumatic aneurism complicating a fracture of the bones of the lower extremity, the ordinary treatment of diffused traumatic aneurism must be departed from, for these reasons :—1. That, owing to the great displacement of parts and laceration of the soft structures consequent on the fracture, it would be almost impossible to find the injured vessel ; and, 2. That, if it were found, the opening up of the limb would leave a large ragged wound communicating widely with the broken bones, and leading to the worst form of compound fracture, with an amount of disorganisation in the limb that could scarcely be recovered from.

However extensively a bone may be comminuted, good union will take place provided the fracture be simple ; that is, provided no wound exist in the limb by which air may gain admission to the fracture or to the soft parts implicated in it. I have seen the lower end of the femur crushed, as if by a sledge hammer, into a multitude of fragments ; and yet excellent union resulted, the fracture being simple, with no breach even of integument. In such a case as this, if there had been the smallest wound to admit air into the limb, suppurative action of the most extensive and destructive character would undoubtedly have set in, and the patient's limb at least, if not his life, would have been lost. It is impossible to overestimate the advantage of an injury of this kind being *subcutaneous*.

A serious complication of simple fractures consists in their *implicating a joint*. The fracture may extend into a neighbouring articulation, and thus give rise to considerable inflammatory action ; in strumous subjects this may lead to ultimate disorganisation of the articulation, requiring excision, which I have several times had occasion to perform in these cases. But in healthy individuals a large articular surface may be traversed by lines of fracture in several directions, without material inconvenience resulting. This we see in impacted fractures of the condyles of the femur or of the lower end of the

radius. In several instances of this kind in which I have examined the limb after death, no sign of disease of the part has been manifested beyond a moderate amount of injection of the ligaments, the fractured incrusting cartilage uniting by plastic matter, and the synovia being clear and free from inflammatory exudation. But, although union of fractures into articulations takes place readily enough, it cannot be expected that the patient will recover as mobile a joint as if the fracture had merely traversed the shaft. In fact, in the majority of these cases, the patient will be left with a joint that is weak, stiff, and painful; and, if in the lower extremity, unable to support the weight of the body for some considerable time. Possibly also, in many of these instances, an impaired joint will be left through life, as the necessary and unavoidable result of the injury, though not unfrequently unjustly attributed to negligence and want of skill on the part of the surgeon.

The complication of *dislocation* with fracture often occasions great difficulty to the surgeon, as it becomes necessary to reduce the dislocated joint before the fracture is consolidated. In several cases of this description which have fallen under my care, I have succeeded in reducing the dislocation at once, by putting up the limb very tightly in wooden splints, so as to give a degree of solidity to it, and to permit the lever-like movement of the shaft of the bone to be employed; and then, putting the patient under chloroform, I have replaced the bone without much difficulty. Should the surgeon have neglected to reduce the dislocation in the first instance, it will be necessary for him to wait until the fracture has become firmly united, and then, putting the limb in splints or in starch, to try to effect the reduction, which, however, will then be attended by very great difficulty.

The existence of an *anchylosed joint* in a fractured limb is a complication that gives but little trouble, beyond the necessity of modifying the splints in such a way as to fit the shape of the limb. I have treated fractures of the thigh and leg under such circumstances with perfect success, by adapting the splints in the angle formed by the stiffened joints.

The *fracture of a bone into the site of an excised joint* presents no peculiarity of importance. I have met with it in the humerus at the elbow, and have treated the case as that of ordinary fracture of the epiphysis.

In cases of simple fracture occurring in the neighbourhood of, or implicating large joints, passive motion is very commonly recommended at the end of from four to six weeks; I think, however, with Mr. Vincent, that this is often apt to do more harm than good, and is seldom required, the natural action of the muscles of the part being fully sufficient to restore the movements of the articulation, which may be assisted by friction and douches.

Amputation is but very seldom required in simple fractures, and I have never had occasion to practise it. Yet, in cases of very extensive and severe comminuted simple fracture of the lower end of the femur, or of the upper part of the bones of the leg, with implication of the knee joint and injury to the popliteal or tibial arteries, as indicated by the cessation of pulsation in the vessels of the foot, removal of the limb might be proper, in order to save the patient from gangrene or diffused traumatic aneurism. But it is only when the main artery has been injured by spicula of fractured bone, that such fractures will require amputation. I have had under my care a man, in whom the condyles of both femora and the left patella were crushed into numerous pieces by a fall from a great height on both knees, the limbs feeling like bags of loose fragments of bone at the seat of the injury; but yet, as neither the skin was broken nor the vessels injured, though both

knee-joints appeared to be disorganised, the limbs were preserved, and a good union ensued.

COMPOUND FRACTURES.—A compound fracture is that form of injury in which there is an open wound leading down to the broken bone, at the seat of fracture. This injury is not only far more tedious in its cure than simple fracture, but infinitely more dangerous. The tediousness depends upon the communication of the fracture with the external air, causing it to unite by a slow process of granulation, instead of by the more speedy adhesive action that occurs in the simple form of injury. The danger is likewise partly due to the same cause; the process of granulation and suppuration being often attended by profuse discharge of pus, from abscesses or long-continued exfoliation of bone, or by the supervention of secondary diseases, such as hectic, phlebitis, pneumonia, or erysipelas, so as to lead to the eventual loss of limb or life. Besides these dangers, which may be looked upon as a remote kind, the violence that occasions a compound fracture often shatters the limb to such an extent, as to lead to the immediate supervention of traumatic gangrene, to the loss of life by hemorrhage, or to the certain and speedy disorganisation of the limb, as the consequence of the re-actionary inflammation.

Question of Removal of the Limb.—As there are, therefore, not only prospective dangers of great magnitude to be encountered in these injuries, but also immediate risk of a very serious character to be met, the first question that always presents itself in a case of compound fracture is, whether the limb should be removed, or an attempt be made to save it. It is of great importance to settle this point at once; for, if amputation be determined upon, recourse should be had to it with as little delay as possible, there being no period in the progress of the case so favourable for the performance of this operation as the first four-and-twenty hours. Should an injudicious attempt have been made at saving the limb, the surgeon must wait until suppurative action has been set up before he can remove it; and then, he will very commonly find that the occurrence of some of the diffuse inflammatory affections of an erysipelatous character will render any operation impracticable; or the supervention of traumatic gangrene may compel him to have recourse to amputation under the most unfavourable circumstances. At a late period in the progress of the case, amputation may be required, in order to rid the patient of a necrosed and suppurating limb that is exhausting him by the induction of hectic.

It is true that primary amputations are very commonly fatal, especially when practised near the trunk; yet this cannot with justice be urged as an argument against their performance, as *primary* amputation should never be had recourse to except in the most severe cases, in which it is evident that the patient's life must in all probability be sacrificed by the unsuccessful attempt to save the limb. In determining the cases in which immediate amputation should be performed, no very definite rules can be laid down, and much must at last be left to the individual judgment and experience of the surgeon. One will attempt to save a limb which another condemns. But, in coming to a conclusion upon this important question, he must bear in mind that, though it is imperative to do everything in his power to save a limb, yet the preservation of a patient's life is the main point, and that course is the proper one which offers the greatest prospect of effecting this. A wise conservatism is much to be applauded, but decision in determining the expediency of amputation is equally the characteristic of a good surgeon. In coming to a conclusion on a question of such vital moment as this, he must be guided, not only by the nature and extent of the fracture,

but by the age, constitution, and habits of the patient ; and though he may be guided by those general rules which have already been laid down at pp. 118 and 131, when treating of amputation in contused wounds and in gun-shot injuries, yet he will often show more wisdom, and the greatest amount of surgical skill, in knowing when to depart from the strict letter of surgical law, and in making a successful effort to save a limb, which, by adherence to surgical precepts, would be condemned ; or in attempting to preserve the patient's life, by sacrificing a limb that is not injured to a degree that would usually be considered to justify amputation.

1. Those fractures must be looked upon as most unfavourable in which the wound is the consequence of the violence that breaks the bone, and in which there is *much laceration of, and extravasation into, the soft parts* ; more particularly if the integuments be stripped off, portions of the muscular bellies protrude, and the plaques of cellular tissue between the great muscles of the limb be torn up and infiltrated with blood. Injuries of this description occurring in the lower extremity always require amputation. Now the danger to the patient increases not only in proportion to the amount of comminution of the bones and of injury to the soft parts, but almost in the exact ratio of the proximity of the injury to the trunk. Thus, amputation of the thigh for bad compound fracture of the leg, though a very serious operation, is sufficiently successful ; but when the femur itself is badly fractured and amputation of the thigh high up is required, recovery can indeed but seldom be expected. A bad compound fracture of the thigh, high up, may almost be looked upon as a fatal accident (*vide* pp. 29-30 and 132). In the arm, such accidents are not so serious, and admit of the member being saved, unless the bones be greatly comminuted.

2. The complication of a compound fracture with the *wound of a large joint*, more especially if there be crushing or splintering of the bones which enter into its formation, with extensive laceration of the soft parts, is one of the most serious injuries that can be inflicted on a limb ; and, when occurring in the lower extremity, it may be looked upon as a case for amputation—unless it be the hip-joint that is so damaged, when there will generally be so much injury inflicted upon the pelvic bones and their contained viscera, as to preclude the performance of any operation. When the elbow or the shoulder-joint is the seat of compound comminuted fracture, with extensive injury of the soft parts, and possibly laceration of contiguous nerves or large bloodvessels, the case is one for immediate amputation. But, if the injury be localised to the bones, the soft parts being in a favourable state, resection of the articulation may advantageously be practised. This operation is usually a somewhat irregular proceeding, being conducted according to the extent of the wound, and consisting rather in picking out the shattered fragments of bone, and sawing off smoothly projecting and sharp-pointed fragments, than in methodical excision.

3. When one of the *larger arteries of the limb has been wounded* by the violence that occasions the fracture, or has been lacerated by the broken bone itself, there may be copious arterial hemorrhage externally, as well as extravasation into the general cellular tissue of the limb. These cases most commonly require immediate amputation. But, whilst the patient is being examined, and preparations made for the operation, care must be taken that a dangerous quantity of blood be not poured out. This must be prevented by the elevated position and by the application of a tourniquet. For want of this simple precaution, I have seen very large and even fatal quantities of blood gradually lost, by being allowed slowly to trickle from the wound.

In these cases it has been proposed, by some surgeons of great eminence, to enlarge the wound in the limb, or to make an incision down to the fracture, and attempt to tie the artery where it has been injured. It is easy to give, but difficult to carry out, such precepts as these. In most cases they are scarcely practicable, as the surgeon would have to grope in the midst of bleeding and infiltrated tissues, and would experience the greatest possible difficulty in finding the wounded vessel, after a search which would materially tend to increase the disorganisation of the limb. Even after the removal of a limb in this condition, it is often by no means easy to find the artery that has poured out blood; and how much more difficult must it not be to search for it successfully during life?

The ligation of the artery at a higher point of the limb does not hold out much prospect of success, for the same reasons that render its employment inadvisable in ordinary wounds of arteries. If, then, proper means directed to the wound, such as position, pressure, or perhaps the attempt at ligation if the artery can be easily reached, be not successful, no course is left to the surgeon but to amputate the limb without delay. This is more especially the case if it be the lower extremity that is injured: in the arm, there is a better prospect of our being able to arrest the bleeding without having recourse to this extreme measure.

4. *Comminution or splintering of the broken bone* is always a serious complication of a compound fracture. Here the case is very different from what occurs under similar circumstances in a simple fracture. Extensive suppuration will set in: the splinters, if completely or nearly detached, will lose their vitality, and not only produce all the irritation that would result from the inclusion of rough and pointed foreign bodies in the interior of a limb, but, if numerous, will, on their removal or separation, leave the member in a shortened and permanently deformed state. The treatment of such cases will depend on the seat of the injury, and the extent of the comminution. Compound and comminuted fractures of the femur, may, except when occurring in the upper third, generally be looked upon as cases for immediate amputation (*vide pp. 131-2*); the only other exceptions being when the comminution is trivial, the splinters large, lying in the axis of the bone, and the subject young. In the arm, fore-arm, and hand, and in the leg, provided the knee and ankle-joints be not involved, much may be done in the way of removal of splinters of detached bone, and in sawing off smoothly the rugged ends of the fixed fragments. The larger attached and "tertiary" should be left, as they will throw out callus, and become buttresses of support to the broken bone (*vide p. 129*). If a considerable quantity of splintered bone have been extracted from a limb, care must be taken that in putting up the fracture too complete extension is not maintained, as a gap would thus be left, which could not be filled up by callus, and a weakened limb would result. It is better to place the bones in proper apposition, and to let the patient recover with a shortened but strong and otherwise useful limb.

5. The complication of a bad compound fracture requiring amputation low down in a limb, with a simple fracture high up, is a serious one. The question that will here arise is; Should the amputation be performed above the compound and below the simple fracture, or above both? The answer to this must depend on the condition of the limb between the fractures. Suppose that there is a badly comminuted and compound fracture of the lower third of the leg, with a simple fracture of the middle of the thigh; or a crush of the hand or fore-arm, with simple fracture of the middle of the humerus, how should the surgeon act? It appears to me that the proper

course to adopt in such a case as this, would mainly depend on the conditions of the intervening soft parts. If these be sound, free from extravasation, not contused or lacerated, the limb may with safety be removed just above the lower fracture, the upper fracture being treated on ordinary principles. But if there be extensive bruising of the limb with ecchymosis or deep extravasation between the fractures, then it would clearly be useless to amputate low down, as the stump would not only have to be formed of tissues in a state of disorganisation, but the inflammation set up at the seat of operation would speedily spread into the tissues, filled by extravasation, and, setting up unhealthy suppuration in this, would spread upwards to the higher fracture, converting it into a compound one of the worst kind. In such cases, therefore, where there is extensive disorganisation of intervening soft parts, it appears to me that the proper course for the surgeon to pursue is to remove the limb at or above the line of the higher fracture.

6. The complication of a *dislocation high up with a bad compound fracture low down*, as when the shoulder is dislocated, and the hand is crushed, is not so serious, the dislocation having been reduced, the limb may be amputated low down with safety. This practice I had occasion to adopt some years since in a young man who met with a bad crush of the hand and forearm, with dislocation of the humerus into the axilla, in consequence of the limb having become entangled in machinery. If, however, the compound fracture, unattended by any of the complications that have just been mentioned, occur in a young and otherwise healthy subject, we must, of course, attempt to save the limb, and shall generally succeed in doing so.

Treatment.—In the management of a compound fracture, more especially of the lower extremity, special apparatus, such as M'Intyre's, Liston's, or the bracket-splints, double inclined planes, swing-boxes, and fracture-beds, are often necessary, in order to obtain access to the wound, so as to dress it properly, and to place the limb in the best position for union. In many cases the starched bandage may very advantageously be used; but it requires caution, as swelling and consequent strangulation of the limb may take place under it.

In the treatment of compound fractures, there are several parts that require special attention. These are 1, the reduction and the management of any protruding bone; 2, the management of splinters; 3, the closure of the wound; and 4, the subduing consecutive inflammation. It is in carrying out these indications that the whole treatment of the injuries is involved, in those cases in which the limb admits of being saved.

The *reduction* of compound fractures must be accomplished with the same attention to gentleness as in that of simple ones. In the majority of cases, no great difficulty is experienced in effecting this; and, after it has been done, the limb should be placed on a well-padded splint, properly protected in the neighbourhood of the wound with oiled silk, so as to prevent soiling of the pads by blood and discharge. In some cases, however, considerable difficulty arises in the reduction, from the protrusion of one of the broken fragments which has been driven through the skin, either by careless handling of the limb in carrying the patient, or else by the muscular contractions dragging the lower fragment forcibly upwards, and thus causing perforation of the integument. The protruded bone must, if possible, be gently replaced, by relaxing the muscles of the limb, and thus bringing the soft parts over it. In some cases, however, it is so tightly embraced by the skin, which appears to be doubled in underneath, that enlargement of the wound becomes necessary before it can be replaced. In other cases, again,

it will be found that reduction cannot be effected or maintained, unless the sharp and projecting point of bone be sawn off. This is best done with an ordinary amputating saw, the neighbouring soft parts being protected with a split card; or else by passing the blade of Butcher's saw under the bone and cutting upwards. The limb, as I have found in several cases in which it has been necessary to have recourse to this procedure, is not ultimately weakened or necessarily shortened by it.

After the reduction, the great object is, if possible, to convert the compound into a simple fracture by the closure of the external wound. No pains should be neglected to effect this desirable end. If it can be accomplished, the tediousness and danger of the case are greatly lessened; the whole process of suppuration, with all its attendant evils, being saved to the patient. But the chance of closing the wound in the soft parts will vary greatly in different cases, depending chiefly on the way in which it has been produced, whether by transfixion of the skin by the sharp angular fragment, or by the direct violence which has occasioned the fracture. In fact, the more the wound partakes of a clean cut, the greater the probability of its closure by the first intention; the more contused it is, the greater the certainty of its suppuration. It appears to me that nothing can be more useless or more unsurgical, than to endeavour to close the wound under the latter circumstances. If the wound be small, clean cut, and occasioned by the protrusion of the fragment rather than by the direct violence which occasions the fracture, we may hope to succeed in our object by following Sir A. Cooper's recommendation of applying to it a piece of lint soaked in its blood, or, what is better, saturated with collodion, and thus obtaining union by direct adhesion. The dressing should be left undisturbed until it becomes of itself, at the end of a week or two, when the wound will probably be found to be closed. If the wound be large and lacerated, if a joint have been opened, if the wound have been inflicted by the same violence that has broken the bone, or if there be much bruising of the edges and surrounding tissues, with extravasation into the limb, suppuration must necessarily ensue, and thus direct union cannot be expected to take place. Under these circumstances, it is in accordance with the best principles of surgery, not to follow the routine practice of attempting to close the wound, which cannot possibly unite by the first intention, but to treat it like any other contused wound, and apply water-dressing from the very first, so as to allow a vent for the discharges that will take place after the first four-and-twenty hours. If these be retained in the limb by the external wound being kept closed by means of a pad of lint, rendered impervious by dried blood or collodion, deep infiltration of the cellular intermuscular planes will ensue, with much local tension and purulent infiltration, accompanied by severe constitutional irritation, followed probably by pyæmia. It is, I believe, in consequence of the free vent thus afforded to the discharges, and to their retention being avoided, that many of the worst-looking cases of compound fracture—especially of the leg—those in which there has been extensive sloughing of the soft parts around the wound, with exposure of the fractured fragments, eventually do the best. The danger in such cases is a remote one, from hectic and exhaustion; not an immediate and grave one, from erysipelas and purulent absorption.

After the position of the limb has been thus attended to, an endeavour must be made to moderate the local inflammatory action, and to lessen constitutional irritation. This is best effected by leaving the part undisturbed and untouched as long as possible. The great art in the successful treatment of compound fractures consists in not disturbing the limb or meddling with

the wound. For days or even weeks the limb may sometimes advantageously be left without interference, when once it has been carefully put up. Should, however, much swelling have taken place, and the wound show no disposition to heal by the first intention, but become inflamed and sloughy, and should much inflammatory action be set up in the limb, this may be moderated by the use of irrigation (Fig. 48), and by the application of cold evaporating lotions. The part should be elevated and but lightly covered, the bed-clothes being well raised by means of a cradle, so as not to press on the limb, and to allow space for the evaporation of the cold lotion; care being taken, at the same time, that the bandages be applied very loosely, merely with a sufficient degree of force to retain the limb upon the splint, as inflammatory infiltration, that might rapidly induce strangulation of the part, is apt to ensue. The constitutional irritation must be subdued by the administration of opiates, together with an aperient, on the morning following the accident; and these medicines must be repeated from time to time during the first few days. Moderate antiphlogistic regimen must be had recourse to, and the patient be disturbed as little as possible. In many cases suppuration rapidly sets in, and, if the patient be addicted to drinking, the constitutional disturbance soon assumes the irritative form: under these circumstances, it is of great moment that support, and even stimulants, be freely given; they must be allowed from the very first, and increased in proportion to the depression of the patient's strength, or as symptoms of nervous irritation come on.

If there be much extravasation of blood into and bruising of the soft parts, great tension of the limb, followed by unhealthy suppuration and sloughing, will take place in the neighbourhood of the wound: free incisions are then required to remove the tension and strangulation of the tissues, and, by letting out the broken-down blood and pus, to lessen the risk of the occurrence of gangrene. It is in these cases that so much injury results from blindly following, as a routine practice in all cases indiscriminately, the treatment which is undoubtedly of the highest value in some; viz., that of keeping a pad that has become hard and impermeable by imbibition of dried blood over the wound, with a view to its closure by the first intention. The natural vent to the discharge through the external opening being interfered with, deep infiltration takes place through the cellular planes of the limb, and the most extensive local mischief may result, pyæmia being almost certain to ensue. So soon as suppuration is fairly established, a light poultice or thick water-dressing should be applied, and the burrowing of matter prevented by making counter-openings where necessary, by the application of a compress, and by attention to the position of the limb. The fracture-apparatus must be kept scrupulously clean, especially in summer; the bandages changed as often as soiled, and the pads well protected with oiled silk. During this period various complications, such as erysipelas, inflammation of the absorbents and veins, and low forms of pneumonia, are apt to occur, requiring special consideration and treatment; so, also, if the discharge be abundant, hectic, with its sweats and gastro-intestinal irritation, may come on, requiring full support of the powers of the system, and the administration of the mineral acids and other remedies, according to circumstances. As the confinement to bed is necessarily very prolonged in these cases, often extending through many weeks and months, the state of the patient's back should be attended to, and he should early be placed upon a water-cushion, or hydrostatic bed, lest sores supervene. As the wound gradually heals, water-dressing must be substituted for poultices, so as not to sadden the parts and encourage suppuration, and in time the red or blue wash for the water-dressing. The bone will often be observed lying white

and bare, bathed in pus, at the bottom of the wound. But even in this apparently unfavourable condition, it may recover itself; lymph gradually being deposited in points on its surface by the action of its own vessels, and becoming vascularised, so as to cover it with a layer of florid granulations; in other cases, necrosis to a greater or less extent will take place, and perfect consolidation does not occur until the bone has separated. Mr. Curling has shown that those portions of necrosed bone are slowest in detaching themselves, which are connected with the lower fragment. In some instances a large quantity of provisional callus is thrown out, in which the necrosed bone is implicated; and then the process of separation becomes extremely tedious and protracted, and amputation may not uncommonly become necessary, from the powers of the patient being unable to bear up in so prolonged a struggle. So soon as some consolidation has taken place, the limb should be firmly put up in gutta-percha or leather splints, with a starched bandage, so as to enable the patient to be got out of bed, to change the air of his room, and thus to keep up his general health. In fitting these splints, care must be taken to make an aperture opposite the wound, through which it may be dressed (Fig. 91).

The time required for the proper consolidation of a compound fracture varies greatly, according to the amount of injury done to the bones and soft parts, and the age and constitution of the patient. Under the most favourable circumstances, it requires double or treble the time that is necessary for the union of a simple fracture. Much stiffness of the limb from rigidity of the muscles and tendons will continue for a considerable length of time; this may gradually be removed by frictions and douches.

Secondary Amputation may become necessary from the occurrence of traumatic gangrene, and then it must be done in accordance with the principles already laid down when speaking of that operation; but more frequently it is required from failure of the powers of the patient in consequence of irritation and asthenic fever, induced by the general disorganisation of the limb, or by hectic resulting from profuse suppuration and slow necrosis of the bones. Under these circumstances, the constitution suffers from the local irritation which is the source of the wasting discharge; but, by removing this in time, and seizing an interval in which constitutional action may have been somewhat lessened, the patient's life will in all probability be preserved, the results of secondary amputation for compound fracture under these conditions being by no means unfavourable. Indeed, it is remarkable to see how speedily the constitutional irritative and hectic symptoms subside after the removal of the source of irritation; the patient often sleeping well, and taking his food with appetite the day after the operation.

The proper period to seize for the performance of secondary amputation in the earlier stages of the injury is often a most critical point. As a general rule, it may be stated that, if the limb be not removed during the first twenty-four hours, eight or ten days must be allowed to elapse before the operation is done, as during that time constitutional irritation and suppurative fever are of too general and active a character to render fresh shock to the system admissible. But when once the actions appear to tend to localise themselves, the suppuration becoming more abundant, the redness extending far away, and the constitutional symptoms merging into an asthenic form, then the limb may be removed with the best prospect of success; the more the action is localised, the better is the chance of the operation succeeding.

In many cases the symptomatic and suppurative fever so rapidly merge into the asthenic form, that the surgeon must seize the best moment he can for the performance of the amputation. Under these circumstances the opera-

tion is seldom very successful; the stump becomes sloughy, erysipelas or diffuse inflammation of the cellular tissue comes on, or symptoms of pyæmia set in, and the patient speedily dies. In other cases again, there is a marked interval between the stages of the inflammatory and suppurative fever and the supervention of the typhoid symptoms, lasting for twelve or twenty-four hours, or even longer. During this, the mischief may be looked upon as in a great measure of local character; the constitution has been disturbed by the setting up of the inflammatory action, but, this having terminated in suppuration, it has not yet become seriously depressed by the continued irritation of the discharge from the injured limb, or poisoned by the absorption of morbid matters from it.

The patient's powers must not, however, be allowed to sink to the last ebb before amputation is performed; as then, if the shock do not destroy life, intercurrent and visceral congestion, or some low form of inflammatory mischief, will not improbably prove fatal. Much as "conservative" surgery is to be admired and cultivated, and hasty or unnecessary operations to be deprecated, I cannot but think that the life of the patient is occasionally jeopardised, and even lost, by disinclination on the part of the surgeon to operate sufficiently early in cases of compound fracture, and by too prolonged attempts at saving the injured limb.

The success of the operation will in a great measure depend upon the after-treatment of the case. Large quantities of stimulants and support are often required in London practice to prevent the patient from sinking. I have often given with the best success eight or ten ounces of brandy, twelve or sixteen of port wine, with two or three pints of porter in the twenty-four hours after these operations, with beef-tea, arrow-root, or meat, if the patient will take it, and have found it absolutely necessary to do so lest death take place from exhaustion.

At a later period than this, when some weeks or months have elapsed, and the fracture has not united, the bones necrosing, and the patient being worn out by hectic, amputation must be performed at any convenient moment, and is often done with great success if it be not deferred too late; for here the mischief is entirely local, and the constitution, suffering only by the debility resulting from it, quickly rallies when the cause of this is removed.

REBREAKING AND RESKINING BONES.—A fracture is occasionally so badly set that it becomes necessary to bend or break the callus, in order to improve the condition of the limb. When the displacement is angular, and the consolidation not very firm, as is usually the case, this may be done pretty readily; but if the displacement be longitudinal, and much time have elapsed since the occurrence of the injury, it will be difficult if not impossible to remedy the deformity. During the first four or five weeks, the bond of union between the fragments is so yielding, that the angular displacement may be remedied by putting up the fracture afresh day by day, by the employment of pressure, and by the application of the roller in the opposite direction to that in which it had been previously applied. After this period, the deformity can only be remedied by forcibly bending or quite breaking the callus, which is best done under the influence of chloroform, and then putting up the fracture again, when speedy and perfect consolidation will ensue. In this way I have several times remedied fractures that had got into a faulty position, although from six to ten weeks had elapsed from the occurrence of the injury.

DELAYED UNION.—Occasionally, more particularly in cases of fracture of the femur, tibia, and humerus, the union between the broken fragments is delayed several weeks beyond the usual period of perfect consolidation.

This arises, in the majority of cases, from constitutional debility, rather than from local causes. When it is found at the expiration of six or eight weeks after the occurrence of simple fracture that the callus is still yielding, the general health should be improved by tonics, change of air, &c., and the limb securely put up in starched or plaster of Paris bandages. Indeed I believe that *delayed union* is much less likely to occur in patients who have from the first been treated by the starched bandage, and allowed to move about, than in those who have been confined to bed or rather to the house in the ordinary way.

UNUNITED FRACTURES AND FALSE JOINTS.—Some bones when broken never unite by callus or plastic matter, their fragments merely being kept firm by the intervention of the aponeurotic structures of the part, as is the case with the patella. This, which is owing to a want of apposition of the fragments, and is dependent on the condition of the part, cannot be considered a diseased action.

It happens, however, occasionally in fractures of the shafts, or of the articular ends of long bones, that proper union has not taken place at the usual time, or does not take place at all. This may be owing to one of three circumstances. 1. No uniting material of a stronger kind than fibro-cellular tissue has been formed; 2. The plastic matter that has been thrown out has only developed into fibrous tissue, not having undergone osseous transformation; or, 3. True bony union has taken place, but, owing to some peculiar state of the patient's health, the callus has become absorbed, and the fracture loosened.

In the first and third conditions we have an *Ununited Fracture*; the ends of the bone, which are rounded and churnated, being merely connected by, and enveloped in, a loose fibro-cellular tissue.

In the second condition we have a *False Joint*, the ends of the bone being tied together by strong fibrous bands. The structure of these false joints, which has been carefully studied by Rokitsansky, presents two distinct varieties. In the first, which partakes of the character of a hinge-joint, we find that the ends of the fracture are smoothed and rounded, invested with a dense fibrous periosteum, and united to one another by thick bands of ligamentous tissue, in such a way as usually to admit of considerable lateral movement, though sometimes they are tolerably firm. In the other variety the joint partakes of the ball-and-socket character, usually to a very imperfect degree, but sometimes in a sufficiently well developed manner, one end of the bone being rounded and invested by periosteum, the other cup-shaped, and covered by firm smooth fibroid tissue. The bones are united by a kind of capsule, in which a synovia-like fluid has occasionally been found.

The form that the false joint will assume depends on the action of the muscles which influence it. Thus, when occurring in the shafts of long bones, where it is subjected to movements of flexion and extension, it will assume the hinge form; whilst when it is seated in the articular ends, where it is more subjected to movements of rotation, it will affect the ball-and-socket character.

Cause. The cases of ununited fracture and of false joint are constitutional and local.

In some cases the *Constitutional Cause* appears to be a cachectic state of the system occurring from some debilitating disease, such as phthisis, scurvy, or cancer, or from any depressing cause, in consequence of which there is not sufficient reparative power for the production or proper development of the plastic matter, by which the fracture should be united. If this have been

deposited, it may, under the influence of these constitutional causes, again become absorbed, and the fractures may thus be loosened; but in many cases no constitutional cause can be detected, the patient being in excellent health, strong, and robust. In spontaneous fractures, union seldom takes place very readily or perfectly.

Pregnancy is said to have a tendency to interfere with the proper union of a fracture; this, however, I consider doubtful, as I have had under my care, and have seen, a considerable number of cases of fracture in pregnant women, which united in the ordinary time.

Age does not appear to exercise any influence on the occurrence of disunion in fractures, which is indeed most common in the early and middle periods of life, when fractures are most frequently met with. I have on two occasions, in my own practice, known very firm and perfect consolidation of fracture of the shaft of the femur to take place in women of ninety years of age and upwards.

The *Local Causes* are various and important. The *anatomical condition* of the fragments, as regards their *vascular supply*, is perhaps that on which want of union is most immediately dependent. For proper union to take place, it is necessary that the callus be deposited from both sides of the fracture. If one fragment be so situated that sufficient blood is not sent to it for this purpose, not only may disunion, but necrosis, occur. Thus we see exemplified in fractures of the superior articular ends of the humerus and femur. In intracapsular fracture of the anatomical neck of the humerus, the globular head, being detached from all its vascular connections, may necrose. In intracapsular fracture of the neck of the femur, the head of the bone, still retaining some vascular connection through the medium of the ligamentum teres, has sufficient blood furnished to it to prevent its death, but not enough to form callus—hence fibrous union takes place. In the shafts of the long bones, the degree of union will be dependent in a great measure on the conditions of the vascular supply to the fragments, through the medium of the nutritious artery. The influence of the rupture of the nutritious artery of the bone by the line of fracture running across it, and thus interfering with the vascular supply of one of the fragments, has been investigated by Guérétin; and the occasional occurrence of atrophy of the bone after fracture, has been shown by Curling to be dependent upon the interruption of the supply of arterial blood through this vessel. Guérétin has collected cases that tend to prove the direct connection between the occurrence of ununited fracture, and the want of proper arterial supply to one of the fragments. Thus, in the humerus the course of the nutritious artery is from above downwards; and of thirteen cases of ununited fracture, nine were found to be situated above the canal in which the vessel is lodged. In the forearm, where the nutritious artery passes from below upwards, of eight cases of ununited fracture, seven occurred below this vessel, and only one above. Mr. Adams has, however, shown that the number and size, as well as position, of the nutrient arteries varies considerably; and hence the objection that non-union may occur in a fracture of any part of the shaft of a long bone, whereas the nutritious artery is only found at one spot, can scarcely be considered a very valid one. It is certainly owing, in a great measure, to this want of vascular supply to the fragment that intracapsular fractures almost invariably unite by fibrous tissue rather than by bone, and that, when bony union takes place, the callus is chiefly formed by the surface connected with the shaft. In some cases of intracapsular fracture of the humerus, no union whatever takes place, the detached fragment *necrosing* in consequence of being entirely deprived of its supply of blood.

Some bones are much more liable than others to disunion of their fractures. According to the statistics collected by NORRIS, it would appear that the femur, the humerus, the bones of the leg, and of the forearm, and lastly the lower jaw, are those in which ununited fractures most frequently occur, and that in the order which has been given.

The occurrence of ununited fracture is occasionally attributed to the *velocity or want of proper apposition* of the fragments, and doubtless in some cases it may be so occasioned: but I believe that these causes are not nearly so frequent in their operation as the constitutional and local conditions that have already been pointed out. The *interposition of a piece of muscle* between the fragments may occasion disunion. Of this I saw an interesting instance some years ago, in which want of union in a fractured femur was owing to the entanglement of a portion of the rectus muscle between the fragments.

The *Treatment of ununited fracture* must not be conducted by local means only; *constitutional measures* should not be neglected. We cannot expect the formation of firm and strong callus unless the general health be in a satisfactory state. If callus have not been formed, or if, after formation, it have been absorbed under the influence of a cachectic state of the system, the improvement of the patient's health, at the same time that the fracture is put up again firmly, so that the ends of the bone are brought into close apposition, may bring about perfect union. I have had under my care at the hospital, a man with ununited fracture of the femur from absorption of the callus four months after the occurrence of the injury, under the influence of incipient phthisis and debility induced by want of food: perfect consolidation of the fracture was produced by giving him cod liver oil and good diet, with rest in bed and a starched bandage to the limb. Hence it is evident that impaired nutrition may occasion disunion, even after a fracture has become consolidated, and that improvement of the nutritive activity of the body may of itself lead to consolidation of the fragments. If there be no very evident cause for the disunion, it will occasionally suffice to put up the fracture firmly in leather or gutta-percha splints, with a starched bandage, and then to allow the patient to move about upon crutches, so that his general health may not suffer, at the same time that a tonic plan of treatment is followed. Indeed, I have seen several cases in which the want of union appears to have resulted from too long confinement of the patient to his bed, and the consequent impairment of his health, consolidation having taken place when a more favourable hygienic system was enforced. This simple plan can, however, only be useful if but a short time, at most some months, have elapsed from the occurrence of the injury. In some cases, the empirical administration of mercury is attended with success. In a case of ununited fracture of the humerus that was admitted into the University College Hospital under Mr. Liston, fifteen weeks after the occurrence of the injury, union was induced within a month by putting up the limb in splints, and salivating the patient. When the disunion arises from malignant disease, nothing can be done.

At the same time with appropriate constitutional treatment, suitable *local means* must be employed to secure steady coaptation of the fragments. In the upper extremity, this may usually be done by means of splints of an ordinary character. In the leg, the starched or plaster of Paris bandage will be found to be especially serviceable. In the case of ununited fracture of the thigh, special apparatus will be required to secure complete fixity and stability of the limb. For this purpose, the limb should be put in an apparatus, consisting of an outer and an inner iron rod having hinge-joints

opposite the hip and ankle, and attached above to a strong pelvic band, and below to the sole of the boot. The thigh part should be provided with well-padded splints, which may be screwed down in opposite directions against the two fragments, so as to hold them firmly in contact. This instrument should be worn for several months; and by it Mr. Smith, of Philadelphia, has succeeded in curing ten out of fourteen ununited fractures in the lower extremity. One great recommendation, is that this plan of treatment is entirely devoid of danger, and enables the patient to take exercise whilst under treatment. In cases where there is much shortening of the limb and riding of the fragments, which is especially apt to occur in the thigh, it will be necessary to employ extension of the limb as well as compression of the fragments against one another. This extension may be made by the lateral iron rods of the above described apparatus being constructed so as to slide, and to admit of extension by means of a rack and pinion or screw mechanism adjusted to them, by which the limb may be gradually lengthened to any required extent.

When the disunion has become very chronic, and a false joint has once formed, it will be necessary to have recourse to operative procedure before union can be attained. All operations that are undertaken in these cases are conducted on one of two principles; either, 1, *to excite such inflammation in the false joint and the neighbouring tissues, as will lead to the formation of lymph capable of undergoing osseous transformation*; or else, 2, *by removing the false joint altogether, to convert the case into a recent compound fracture, and to treat it in the same way that such an accident would be managed*. It can easily be understood that operative procedures conducted on these principles are of too serious a character to be lightly undertaken, or to be had recourse to until other measures have failed, the mortality following them being, even according to published statistics, considerable, and probably very much greater than has been laid before the profession.

1. Among the first set of operations,—those that have in view the *Excitation of sufficient Inflammation to cause Deposit of proper Plastic Matter*,—the simplest procedure consists in the introduction of *acupuncture needles*, or in the *subcutaneous section* of the ligamentous band with a tenotome. In this way I have known union effected in a patient of Mr. Liston's, who had a false joint in the shaft of the femur; though not until after the fracture had been converted into a compound one, and much danger and suffering incurred. Four years after the consolidation of the ununited fracture, the patient was readmitted into the hospital, under my care, with fracture of the same bone two inches lower down than the former injury; on this occasion, union took place in the usual manner and time without any difficulty.

The introduction of a seton across the false joint, though occasionally successful, is apt to give rise to dangerous and even fatal consequences, from arterial hemorrhage, erysipelas, diffuse inflammation, and suppuration of the limb. The threads must not be left in beyond a few days, when sufficient action will have been induced. A modification of the seton consists in passing a silver wire around the fracture, and gradually tightening this, so as to cut through the false joint at the same time that inflammatory action is excited in it. In performing this operation, it must be borne in mind that large arterial branches, and even the main trunk, especially in the thigh, may become firmly attached to the callus, so that unless care be taken they may readily be wounded.

Dieffenbach has proposed to excite the requisite degree of inflammation by drawing, with a mallet, three or four conical ivory pegs into holes bored

by means of a gimlet or drill (Fig. 93) in the ends of the fractured bone, which are exposed for this purpose. The soft parts are then to be laid down, and after a few weeks the pegs, which have loosened in consequence of the removal or absorption of their ends, should be taken out. It is not necessary or even desirable to endeavour to pin together the ends of the broken bone, but merely to introduce the pegs into the extremities of both fragments near to the seat of fracture. It is, however, especially in ununited fractures of the humerus, that this can be successfully done, the irritation of the pegs appearing to occasion an effusion of a large quantity of callus sufficient for the consolidation of the fracture. This operation I have practised with great success in several instances of ununited fracture of the humerus. In one case that was recently under my care, there was a false joint at the junction of the upper and middle thirds of the bone, complicated with an elbow ankylosed in the straight position; here, after flexion of the stiff elbow, perfect consolidation of the humerus was effected by the use of five pegs. In the ununited fractures of the bones of the leg and forearm, it is also likely to be serviceable, but in the femur not so much so. Indeed, in the cases of ununited fracture of this bone, I have known more failures than successes after this operation.



Fig. 93.—Drill for treating False Joint.

2. The operation of *Removing the False Joint* may be performed by cutting down upon it, and resecting the ends of the bones, or else by destroying the articulation with caustic potash. The excision of a false joint is necessarily a dangerous operation, and by no means a successful one; erysipelas, phlebitis, and diffuse suppuration of the bone, occasionally supervening. Of 39 cases collected by Norris, in which the ends of the bones were either resected or scraped, 24 were cured, 7 derived no benefit, and 6 died. In those cases of the operation that are successful, some shortening of the limb must be expected to result; and, if the fracture be very oblique, it would of course be impossible to remove more than a very limited portion of it, and, consequently, very perfect union could scarcely be anticipated. The application of caustics to the exposed bones is so coarse and uncertain a method, as to find but little favour amongst surgeons of the present day.

On reviewing the various methods that have been recommended for the re-establishment of union between the separated fragments, it would appear that the excitation of proper inflammatory action, by the introduction of the wire, or by driving in ivory pegs, promises the most satisfactory result. It is by no means necessary to remove the fibrous band that intervenes between the fragments in cases of false joint; for, if the proper amount of inflammatory action be set up, this either undergoes osseous transformation, or a sufficient quantity of callus is thrown out around it to consolidate the fracture. If union should fail to be accomplished, and the false joint were situated in the femur or the bones of the leg, the limb might be so useless and cumbersome to the patient, that amputation might be required as a last resource.

CHAPTER XIX.

SPECIAL FRACTURES.

IN considering the nature and treatment of fractures of particular bones, we shall at present confine our remarks to Fractures of the Face and Extremities. Injuries of the bones of the head and spine derive their principal interest and importance from their complication with lesion of some internal and contained organ; hence the consideration of these can with more propriety be referred to that of these parts.

FRACTURES OF THE FACE AND TRUNK.

NASAL BONES.—These, being thin as well as exposed, are not unfrequently broken. When fractured, they may remain undisplaced, but are more commonly depressed; the ridge of the nose being beaten in. The swelling and ecchymosis that usually attend their fracture render detection difficult, and must be reduced before any treatment is adopted. The bone which is depressed should be raised with the broad end of a director, or by the introduction into the nostril of a pair of polypus forceps, which expand in opening, and push the bone into proper position.

If the *septum* alone be broken, the same treatment must be adopted towards it. Usually, after it has been replaced, the position is maintained; but in some cases, where there is a tendency to sinking of the nostrils, the introduction of a plug into the nares will be required to replace and retain the bones. The hemorrhage, which is usually pretty abundant, may be stopped by the application of cold; but occasionally the nostrils require plugging. If the *lacrimal bone* be broken, together with the nasal, the *ductus ad nasum* may be obstructed, and the course of the tears diverted. In an injury of this kind, I have seen extensive emphysema of the eyelids and forehead occur on the patient attempting to blow his nose. In some cases the injury inflicted to the nasal bones extends through the ethmoid to the base of the brain, and may thus occasion death. This I have seen happen from a severe blow on the face with a piece of wood.

MALAR AND UPPER JAW BONES.—These are seldom broken unless great and direct violence has been employed, and their fracture is usually accompanied by external wound, as in gun-shot injuries of these parts. More commonly the alveolar processes are detached, and the teeth loosened. The treatment then consists in binding the teeth together with gold wire. In some rare cases, all the bones of the face appear to have been smashed and separated from the skull by the infliction of great violence. Thus, South relates the case of a man who was struck on the face with a handle of a crane, and in whom all the bones were separated and loosened, "feeling like beans in a bag." Vidal records the case of a man, who, by a fall from a great height, separated all his facial bones. In fractures of the *zygoma*, the fragments may be driven into the temporal muscle, and produce so much difficulty to mastication as to require removal.

In *Gun-Shot Injuries of the Face*, there is usually great splintering of the bone. As, however, the vitality of the part is great, necrosis is not so likely to ensue here as elsewhere; and the partially detached and loosened fragments may accordingly be put back into position, and will usually recover themselves. There are, however, two principal dangers in these cases; viz.

necessary, they may be tied to the sound teeth with gold wire, or dentists' silk. Care must be taken that any tooth that may have been forced out of its alveolus and dropped



Fig. 96.—Apparatus applied to Fracture of Lower Jaw

between the fragments be removed from this situation; as, in one case where a tooth was overlooked in this position, no union of the fracture took place till it had been removed. When depression, especially near the symphysis, is considerable, a clamp apparatus which fixes the chin and the line of teeth, invented by Lonadale, answers the purpose of steadying the fragments extremely well.

In *Fractures of the Body of the Lower Jaw by Gun-Shot Injury*, there is great comminution and splintering of the bone, followed by copious and fetid discharge, which, being in part swallowed, may reduce the patient to a state of extreme debility or induce symptoms of a typhoid character, which may prove fatal. In these cases, Dupuytren recommends the lower lip to be cut through, the

splinters taken away, and, if necessary, a portion of the bone resected, so as to convert the wound into one similar to what results after the partial removal of the lower jaw for disease of the bone.

FRACTURE OF THE HYOID BONE is of very rare occurrence; and, though usually the result of direct violence, as a forcible grasp, has been seen by Ollivier D'Angers to occur from muscular action. The signs are always very obvious. The fragments form a sharp salient angle: there is much pain and irritation, increased by speaking and deglutition. There is usually salivation; and considerable difficulty in breathing may be present. *Reduction* is accomplished by pressing the fragments into apposition, either externally or by passing the finger into the mouth. Should one piece of the bone be driven much in, it might possibly require to be drawn forwards with a tenaculum. The head should then be fixed with a stiff pasteboard collar to prevent displacement.

FRACTURE OF THE RIBS AND COSTAL CARTILAGES.—These injuries commonly arise from direct violence, the part that is struck being driven in towards the thoracic cavity, and thus broken. In other cases again the fracture occurs from indirect violence, the fore part of the chest being forcibly compressed, so that the rib is bent outwards, and thus snaps. When the injury is the result of direct violence, the pleura, lung, liver, or diaphragm, may be wounded, thus giving rise to the most serious and fatal consequences, such as hemorrhage, emphysema, and inflammation of the parts injured. When it is occasioned by indirect violence, the thoracic organs may be contused and thus injured; although as the fracture takes place in a direction outwards, they are not under the circumstances liable to be punctured by the fragments. In some rare cases the ribs have been known to be broken by the violent contraction of the abdominal muscles during parturient efforts. Fractures of the ribs may be *single*, one only being broken; *multiple*, several, or even the whole of the ribs on one side, or several on both sides, being fractured; *simple*, as in ordinary violence; and *compound*, as in gun-shot injuries.

Any one of the ribs may be broken, and frequently several are fractured at the same time. The middle true ribs are those that most frequently give way, being most exposed, and at the same time fixed. The first and second ribs are seldom broken, being protected by the clavicle and shoulder; when they are fractured, the injury is always very dangerous, on account of

hemorrhage, either primary or secondary, and abundant fetid muco-puriform discharge. The primary hemorrhage usually ceases spontaneously, or on the application of cold. If secondary, it may be arrested by cold, by plugging, and pressure; or, if continuous, and from deep sources, may possibly require ligature of the carotid. The fetid secretion from these wounds is not only a source of great discomfort to the patient, but of positive danger, as, by its miasmatic effluvia or by finding its way into the stomach, it may occasion typhoid symptoms. This risk is best obviated by scrupulous attention to cleanliness, by repeated injections with warm water or chlorinated lotions.

LOWER JAW.—This bone is frequently broken, owing to its prominent situation; though its arched shape enables it to resist all but extreme degrees of violence. Fractures of this bone are usually compound, the laceration of the gum causing them to communicate with the external air. And not unfrequently they are comminuted as well; but yet, from the freedom of the vascular supply to the bone, rapid and very perfect union takes place in it.

Fracture of the lower jaw may occur in various situations. I have seen it most frequently in the *body of the bone* near the symphysis, extending between the lateral incisors; or between these teeth and the canine. The *symphysis* itself is not so commonly fractured, the bone being thick in this situation. The *angle* is frequently broken, but the neck and coronoid process rarely give way.

The *Signs* of fracture of the lower jaw are very obvious. The great *mobility* of the fragments, the *crepitus*, the irregularity of the line of teeth and of the arch of the jaw, laceration of and bleeding from the gums, and dribbling of saliva, indicate unequivocally the nature of the injury. The displacement and mobility of the fracture are greater, the nearer it is to the *symphysis*. If the bone happen to be broken on both sides of this line, the middle fragment is much dragged out of place by the depressor muscles attached to it. In fracture about the angle and ramus, the deformity is not so great, owing to the muscles that coat and protect each side of the bone in this situation preventing the fragments from being displaced.

The *Treatment* is simple enough in principle, though often not very easy of accomplishment. It consists in maintaining the parts in apposition by suitable apparatus for four or five weeks, during which time mastication must be interdicted, the patient living on sop, soups, and fluid nourishment of all kinds, and talking being prohibited. The apparatus that commonly suffices consists of a gutta-percha splint (Fig. 94) moulded to the part (Fig. 95),



Fig. 94.—Gutta Percha Splint. Original Shape.



Fig. 95.—Gutta Percha Splint moulded to Shape of Jaw.

properly padded, and fixed on with a four-tailed bandage; the two fore-ends of which are tied behind the neck, whilst the other two are knotted over the top of the head (Fig. 96). When the ramus is broken, the side of the paste-board cup-splint should be made proportionately long. The teeth in these cases require special attention. Any that are loosened must be left in, as they will probably contract adhesions, and fix themselves firmly; and, if

necessary, they may be tied to the sound teeth with gold wire, or dentists' silk. Care must be taken that any tooth that may have been forced out of its alveolus and dropped



Fig. 96.—Apparatus applied to Fracture of Lower Jaw

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Any one of the ribs may be broken, and frequently several at the same time. The middle true ribs are those that give way, being most exposed, and at the same time fixed; *second ribs* are seldom broken, being protected by the clav; when they are fractured, the injury is always very danger

the importance of the subjacent structures. The lower ribs, being less firmly fixed than the others, commonly escape, unless very great and direct violence be inflicted upon them. Any part of a rib may be broken by direct violence, but when the fracture is the result of compression of the chest, it is usually the convexity or the neighbourhood of the angle of the rib that gives way. These fractures most commonly occur in elderly people, in whom the elasticity of the thoracic parietes has lessened as the result of age.

Symptoms.—The chief symptom complained of is a sharp pricking and catching pain at the seat of injury, increased by breathing deeply, or by coughing. In order to avoid this, the inspirations are shallow, and the breathing is principally diaphragmatic and abdominal. On laying the hand over the seat of injury, and dearing the patient to cough, crepitus may often be felt; and in most cases this is audible on applying the ear to the chest. Occasionally the outline of the rib will be found to be irregular; and in some instances, where several ribs are broken, the whole side of the chest is flattened and depressed. Besides these local symptoms, special phenomena resulting from the complication of wound or laceration of the lung, such as spitting of blood, pneumothorax, or emphysema, may occur. The danger of fractured ribs depends entirely on the thoracic complications, and these will chiefly be occasioned by one of two conditions; either the forcible driving in of the fractured end of one rib, so that the pleura and lung become wounded by the sharp and ragged ends of the fragment; or else by a large number of ribs being broken by a severe squeeze of the chest, and the thoracic organs injured by the general compression they thus sustain. It is surprising, however, what an extent of injury may take place in this way, and yet no serious consequences ensue. I have had under my care a young man who, in consequence of a crush of the chest in a railway accident, had the upper seven ribs broken on the right side, and the lower five on the left, the chest, especially on the right side, being greatly flattened, but who recovered without a bad symptom. In gun-shot injuries of the chest, with splintering of the ribs, there is always wound of the contained organs, which becomes the main source of attention on the part of the surgeon.

Treatment.—In treating fractured ribs, the surgeon need not concern himself so much about the union of the fracture, as about the prevention of pain to the patient in breathing, and of the subsequent occurrence of serious inflammation or other mischief within the chest.

Any displacement that may exist usually remedies itself without the necessity of the surgeon interfering. The chest-wall, even when extensively flattened, gradually expands under the influence of the respiratory movements. If, however, a portion of the rib continue depressed, it had most certainly better be left so: the suggestions that have been made for elevating these fractures by means of sharp hooks and screw-probes, being more likely than the continuance of the depression to occasion serious mischief to the contents of the thorax. In order to prevent undue motion of the broken bone and consequent irritation produced by its puncturing the pleura, or lung, the movements of the injured part of the chest may be restrained by the application of a broad flannel roller, or of a laced napkin round it. Instead of, or in addition to these means, I have for many years just found it more useful to apply a roll of adhesive plaster round the chest. The plaster must be about a foot in width, and should be sufficiently long to make one and a half turns round the body. It should be applied very snugly, and may be left on for ten days or a fortnight, when it may require reapplication. It supports the chest more firmly and evenly than an ordinary bandage, affording the patient great comfort. If the lower ribs be

broken, the diaphragm may become inverted by the projection inwards of the fractured bone; and if the plaster and bandage be applied too tightly, spasmodic action of that muscle may ensue, occasioning distressing dyspnoea.

In gun shot injuries of the chest with splintering of the ribs, all broken spicula of bone must be carefully picked out, and the wound lightly covered with water dressing. In such cases, the grave injuries usually sustained by the intrathoracic organs will absorb the surgeon's attention; and for their treatment I must refer to chapter xxvi.

The prevention of inflammatory action must be attempted, by the employment of bleeding if necessary; but certainly by the adoption of a spare diet and complete rest. Any complication that may occur, such as emphysema, or inflammation of the lungs or pleura, must be treated in accordance with the principles that will be laid down in speaking of injuries of the chest generally.

It occasionally happens that one or more of the *Costal Cartilages*, especially the fifth, sixth, seventh, or eighth, is broken by direct violence. They may be separated from their junction with the rib, or broken across the middle. The existence of fracture may be determined by the pain on pressure, mobility and irregularity at the seat of injury. The same treatment is required for this fracture as for a broken rib; the broken cartilage most commonly uniting by a bony callus which surrounds the fractured ends.

FRACTURE OF THE STERNUM.—The sternum is not readily fractured by any ordinary degree of external violence; owing to its lying, as it were, on an elastic bed formed by the costal cartilages. It has been known to be broken, though very rarely, by the violent straining efforts that occasionally occur during parturition.

Its fractures are always transverse, usually single, but sometimes multiple. I have seen it broken into three nearly equal fragments by a fall from a scaffold.

The displacement of one of the fragments is sometimes considerable; but even if it be not, the very superficial situation of the bone will always enable the surgeon to judge of the exact nature of the injury it has sustained, the signs of which resemble those of a fractured rib.

The *Treatment* must be conducted on the same principles as in a broken rib, and presents nothing deserving of special attention. Indeed, when fracture of the sternum occurs from external violence, it is commonly associated with fracture of the ribs, near the angles; and then the chest-bandage or plaster answers equally for both injuries. Should the sternum be broken during parturition, the patient should be made to sit up in bed, with the shoulders supported and leaning forwards slightly, so as to take off the tension of the abdominal muscles.

FRACTURES OF THE UPPER EXTREMITY.

THE CLAVICLE is often broken, partly owing to its exposure to direct violence, and partly to its action in keeping the shoulder at a proper distance from the trunk. Being the only direct osseous support of the upper extremity, it receives, by transmission through the scapula, every shock that is communicated to the hand when the arm is in an extended position; hence blows on the shoulder and falls on the hand are common causes of fractured clavicle. This bone would be more frequently broken than it is, were it not that it resembles two segments of a circle looking in opposite directions, so as to form an S shape, which admirably enables it to withstand indirect violence.

Both clavicles are occasionally, though rarely, fractured. In one such case, which was under my care at University College Hospital in 1861, the patient, a young man of 20, had sustained this injury, and had twelve ribs broken as well, in a railway accident. Notwithstanding this serious complication, he made an excellent recovery.

The clavicle may be fractured in three situations. 1. Most frequently the *Great Convexity* is broken; the bone bending here when pressed upon from its extremity, the curve becoming increased, and at last giving way. This fracture may arise from direct violence, but usually is the result of falls on the hand or shoulder. 2. It may be fractured nearer the acromion, *under the Acromio-clavicular and Coraco-clavicular Ligaments*. 3. Its *Tip* may be broken off externally to the outermost point of insertion of the trapezoid ligament, between it and the acromion. These latter two fractures can scarcely occur from indirect, but are almost always the result of direct violence.

The *Signs* will depend upon the seat of fracture. When the bone is broken *between the conoid and trapezoid ligaments*, there is little if any displacement, but pain on pressure, some crepitus on moving the shoulder, and slight irregularity in running the finger along the bone. When the fracture is *external to the trapezoid ligament*, there is a remarkably oblique displacement of the osseous fragment, the articular surface of which is turned forwards and inwards, with a slight inclination downwards, nearly at right angles to the rest of the bone, apparently by the dragging of the weight of the shoulder, the point of which, with the scapula, is rounded forwards (Fig. 98). When the fracture occurs *about the middle of the bone*, or at any part on the *sternal side of the scapular ligaments*, there is a remarkable degree of deformity, owing to a triple displacement of the outer fragment inwards, downwards, and slightly backwards. This displacement is owing to two causes, one of which is mechanical and the other muscular. The displacement downwards is owing to the weight of the arm dragging the fragment down. The displacement inwards, with rotation of the shoulder forwards and pointing of the sternal end of the outer fragment backwards, is owing to muscular action, and is due to the action of the muscles that pass from the trunk to the shoulder drawing the scapula and the whole of the upper extremity forwards and inwards towards the mesial line, when the support of the clavicle is removed. The outer extremity of the inner fragment appears to be elevated, the skin being drawn tensely over it; but this is rather owing to the depression of the outer portion of the bone; it is in reality kept fixed by the antagonism between the sterno-cleido-mastoid and great pectoral muscles.

On looking at a patient with fracture of the clavicle in this situation, the nature of the injury is at once evident. The flattening of the shoulder, with its point approximated towards the sternum; the great prominence formed by the inner end of the fragment, over which the skin is tightly stretched; the sudden depression under this, and the crepitus, which can be easily induced by raising and rotating the shoulder at the same time that the elbow is pressed to the side, indicate in the most unequivocal manner the nature of the injury. The attitude of the patient is remarkable; he sits, *raising his head down to the affected side, so as to relax the muscles, and supports his elbow and forearm in the sound hand, in order to take off the weight of the limb.*



Fig. 97.—Healthy Clavicle.



Fig. 98.—Fractured Clavicle.

Fracture of the clavicle not unfrequently occurs in infants, and is apt to be overlooked. The child cries and suffers pain whenever the arm is moved. On examination, an irregularity with some protuberance will be felt about the centre of the bone. Not unfrequently, in very young children the clavicle is merely bent, or at most fractured at one side only.

Comminuted Fracture of the Clavicle from direct violence is often a serious accident, as the subclavian vein and subjacent plexus of nerves, or the upper part of the chest, may be seriously injured. In a case of this kind that was under my care some time since, the subclavian vein was apparently wounded, great extravasation of blood taking place about the shoulder and neck, and the circulation through the veins of the arm being so much interfered with as to threaten gangrene. The case, however, did perfectly well under the continuous application of arnica lotions to the shoulder, and attention to the position of the arm.

Treatment.—When the fracture occurs at the tip of the acromial end of the clavicle, there is little if any linear displacement of the broken bone, and a figure-of-8 bandage round the shoulders, and keeping the arm in a sling, will prevent the tendency to rotation of the shoulder forwards. When the bone is broken underneath the scapulo-clavicular ligaments, there is but little displacement, and the same treatment will suffice.

But when the fracture is situated towards the middle of the bone, or indeed at any point to the inside of these ligaments, then the management is more difficult; and there are three principal indications to be attended to in order to correct the triple displacement of the scapular fragment.

1. By placing a thick wedge-shaped cushion with its broad end upwards in the axilla, and then bringing the elbow closely to the side, the outer fragment is drawn outwards. 2. By pressing the elbow well backwards, the tendency to rotation forwards of the shoulder is removed, and the broken bone is brought into proper position. 3. By elevating the shoulder, and taking off the weight of the arm by means of a short sling that passes well under the elbow, the displacement downwards is remedied.



Fig 99.—Treatment of Fractured Clavicle.

In applying the necessary apparatus, care must be taken to bandage the fingers separately, to pad the palm of the hand with cotton wadding, and to apply a roller up the arm as high as the axillary pad. Before applying the roller, the elbow must always be flexed; otherwise undue and dangerous constriction of the arm may occur. The pad should be firm, made of bed-tick stuffed with bran, six inches long, five broad, and three thick at its upper part; the sling must support the elbow, and the hand should be well raised across the chest. In the accompanying figure, the sling does not extend so far towards the elbow as it ought to. This has been done in order not to conceal the other parts of the apparatus (Fig. 99).

The elbow must be kept to the side by a few turns of a roller, or by means of a padded belt. In children, in whom these fractures often occur, there is frequently a difficulty in keeping the bandages properly applied; under these circumstances the starched apparatus will be found very useful, care being taken to re-apply it as often as it becomes loose, lest deformity result. It has been recommended to treat fractured clavicles occurring in females, to whom

any irregularity of union in this situation would be very annoying, by keeping the patient in bed for the first two or three weeks.

When both clavicles are broken, the patient should be kept in bed, and the shoulder fixed and drawn backwards by means of a figure-of-8 bandage. In the case already alluded to (p. 253), this could not be borne, owing to the simultaneous fracture of the ribs; but the patient nevertheless made a good recovery.

FRACTURES OF THE SCAPULA.—1. *Fracture of the Body of the Scapula* is not very commonly met with; and when it occurs, being always the result of considerable direct violence, it is usually associated with serious injury to the subjacent ribs and trunk. The thick layer of muscles overlying this bone not only protects it, but prevents displacement, and renders the detection of its fracture difficult. The fracture usually takes place across the bone, immediately below the spine; but occasionally it may be split longitudinally or starred.

The *Treatment* consists in placing the arm in a sling, the application of a bulky bandage, and support of the part with a pad. But all surgeons who have seen this accident are agreed as to the extreme difficulty of obtaining union without considerable deformity; which, however, is of less moment here than in most other situations.

Fractures in the Vicinity of the Shoulder-Joint are of common occurrence, and may happen either in the bony points of the scapula that overhang this articulation, or else in the upper end of the humerus. Not unfrequently there is double fracture in the neighbourhood of this articulation; thus the acromion may be broken, as well as the neck of the humerus. These complications necessarily throw some difficulty in the way of the diagnosis of these fractures. In many cases, also, the amount of contusion, and the rapid swelling that takes place, obscure the nature of the injury.

2. The *Acromion*, forming as it does the very tip of the shoulder, is more frequently broken than any other part of the scapula. But, in spite of its exposed situation, fracture of this bone is not a very common accident, at least I have seen but few cases of it, and there is good reason to believe that many of the cases of supposed fracture are in reality cases of delayed ossification of the line of junction between the base and the epiphysis. Notwithstanding this source of fallacy, there can be no doubt, as is proved by numerous preparations, that this fracture does occur.

The *Signs* of this fracture are very obvious. When the acromion is broken off near its root, the arm hangs as a dead weight by the side, and the patient, feeling as if his arm were dropping off, supports it with the other hand. There is flattening of the shoulder, which is most marked when the patient is looked at from behind; and the head of the humerus can be felt somewhat lower in the axilla than natural. On running the finger along the spine of the scapula, a sudden inequality in the line of the bone can be detected; and, on raising the elbow and rotating the arm, crepitus can be felt, the rounded outline of the shoulder being restored.

In many cases the tip only of the acromion is broken off. When this happens, the nature of the injury may be suspected by the patient being unable to raise his arm to a level with his head, so as to touch the crown, owing to some of the fibres of the deltoid having lost their points of attachment, and it may be determined by the existence in a minor degree of some of the preceding signs, which prevent the accident from being confounded with paralysis of the deltoid from contusion.

The *Treatment* consists principally in raising the elbow, so as to take off the weight of the limb, and to push up the acromion by the head of the

humerus. If the extremity only be broken off in front of the acromio-clavicular articulation, a pad may be placed between the elbow and the side, in order to direct the arm somewhat upwards and inwards, and the limb must be fixed in this position by a bandage and sling. Should the fracture have taken place at or behind the line of the clavicular articulation, the treatment must be the same as that for fractured clavicle.

When the base of this process is broken across, union usually takes place by bone. When the apex is detached, fibroid or ligamentous union generally

3. The *Coracoid Process* is but seldom broken; never, indeed, except by very direct violence. There is in the museum of University College a preparation showing a fracture of the base of this process, implicating and extending across the glenoid cavity, and complicated with fracture across the base of the acromion. The attachment of such powerful muscles as the pectoralis minor, biceps, and coraco-brachialis, displaces the fragment considerably, and would do so still more, were it not that it is kept in position by the ligaments to which it gives insertion, and whose fibres are expanded over it.

The only *Treatment* that can be adopted is to put the arm in a sling and fix it to the side.

4. *Fracture of the Neck of the Scapula* immediately behind the glenoid cavity has never been met with on dissection; and there can be little doubt that Sir A. Cooper and Mr. South are correct in stating that cases so described are, in reality, instances of fracture of the upper end of the humerus. There is, according to Mr. South, no preparation in any museum in London illustrating fracture of the neck of the scapula. Indeed, on looking at the great strength of this portion of the bone, and the way in which it is protected by the other parts about the shoulder, it is difficult to understand how it can be broken, except by gun-shot violence.

FRACTURES OF THE HUMERUS.—In studying the fractures of the humerus, we must divide that bone into three parts,—the Upper Articular End, the Shaft, and the Lower Articular Extremity.

1. *Fracture of the Upper Articular End* of the humerus not unfrequently occurs, constituting an important class of injuries which have been carefully studied by Sir A. Cooper, and more recently by Dr. R. W. Smith, whose work on *Fractures* deserves the attentive perusal of every practitioner.

Five kinds of fracture of the humerus are met with in the immediate vicinity of the shoulder-joint. Two of these are *Intracapsular*, viz., Simple Fracture of the Anatomical Neck, and Impacted Fracture of this portion of the bone. The remaining three are *Extracapsular*, viz., Fractures of the Surgical Neck—Simple and Impacted; and Separation of the Great Tubercle from the head of the bone.

Intracapsular Fracture of the Neck of the Humerus.—When the fracture occurs at the *anatomical neck*, the head of the bone is detached from the tubercles, a little above or at the line of insertion of the capsule. This fracture is occasioned by severe falls on the shoulder, and is most frequently met with in adults.

The signs of this injury are by no means very distinct, though much light has been thrown upon them by the labours of R. W. Smith. There is loss of motion in the shoulder, with some swelling and considerable pain, together with some deformity; an irregularity, produced by the upper end of the lower fragment, can be felt towards the inner side of the joint; *crepitus* is easily produced; and there is, on measurement from the acromion to the olecranon, shortening to the extent of about one-third of an inch.

When this fracture is *impacted*, the upper fragment penetrates the lower one. In consequence of this, the axis of the humerus is directed somewhat inwards towards the coracoid process; here also some irregular osseous swelling may be detected. The head of the bone can be felt in the glenoid cavity, but is not in the axis of the limb, the elbow projecting slightly from the side, there being at the same time a hollow some little distance under the acromion. There is consequently more deformity about the joint in the impacted than in the simple intracapsular fracture, with the same impairment of motion, but only slight crepitus on firmly grasping the shoulder and rotating the elbow.

In fracture of the anatomical neck of the humerus, the portion of bone broken off is truly a foreign body in the joint, and, being unconnected with any ligamentous structure, may perish, and thus give rise to destruction of the articulation. When this does not take place, it is probable that impaction of the fragment has occurred, and that thus its life is maintained; or it may happen, as R. W. Smith supposes, that its vitality is occasionally preserved in consequence of some partial union being kept up between it and the rest of the bone by untorn shreds of capsule. In either case, the principal reparative efforts are made by the lower fragment, which deposits callus abundantly.

Treatment.—As there is often much swelling from contusion in these cases, evaporating lotions should be had recourse to for a few days. A pad may then be placed in the axilla, and a leather or gutta-percha cap fitted to the shoulder and upper arm, the limb having previously been bandaged. The hand must be supported in a sling, and the elbow fixed to the side. In examining and reducing these intracapsular fractures, no violence should be employed, lest the impaction of the fragment be disturbed, or portions of untorn capsule, on which the ultimate osseous repair of the injury is dependent, be broken through.

Extracapsular Fracture of the Neck of the Humerus.—In this injury, the bone is broken through the surgical neck, or that portion which is below the tubercles, but above the insertions of the pectoralis major, latissimus dorsi, *teres major*, and deltoid muscles. This accident may occur in children as well as in adults; in the former, the separation takes place through the line of junction between the epiphysis and the shaft of the bone. In this fracture there is double displacement; the head of the bone and upper fragment are rotated outwards, being under the influence of the muscles inserted into the great tubercle, whilst the shaft is drawn upwards and inwards under the coracoid process, by the muscles going from the trunk to the arm, and by the flexors of the limb.

The *Signs* of this fracture are sufficiently obvious. The glenoid cavity is filled by the head of the bone, which can be felt in it. Below this there is a depression; crepitus is easily produced, and there is great mobility of the lower fragment, and shortening of the limb to the extent of from three-quarters to one inch; but the most remarkable sign is the prominence formed by the upper end of the shaft of the humerus, which projects under the integuments, and can readily be felt under the coracoid process, especially when the elbow is pushed upwards and rotated. The axis of the bone is also directed obliquely upwards and inwards towards this point. In consequence of the irritation of the nerves of the axillary plexus by this fragment, which is often very sharp and angular, a good deal of pain is complained of in the arm and fingers. This sign, however, is not met with in children, owing to the greater smoothness of the fractured surfaces.

Impacted Extracapsular Fracture of the Neck of the humerus has been

especially treated of by R. W. Smith in his excellent work on *Fractures*. In this injury, the superior fragment being penetrated by the inferior one, the continuity of the bone and its firmness are in a great measure preserved; hence, the usual signs of fracture, such as mobility, displacement, and crepitus, are not readily obtainable, and indeed the signs of this injury are chiefly negative. Thus, there is impairment of motion, slight deformity about the joint and upper part of the arm, and some crepitus; but only obtainable with difficulty, and by firmly grasping the head of the bone whilst the elbow is being rotated.

The *Treatment* usually recommended consists in bandaging the limb, putting a pad in the axilla, a leather or gutta-percha cap over the shoulder, bringing the elbow well to the side by means of a bandage, and supporting the hand only in a sling, so that the weight of the arm may be allowed to drag on the lower fragment, and thus lessen the displacement. (Fig. 100.)



Fig. 100.—Treatment of Fracture of the Neck of the Humerus.

In the management of these fractures, I have found a very convenient apparatus to consist of a leather splint about two feet long by six inches broad, bent upon itself in the middle, so that one half of it may be applied lengthwise to the chest, and the other half to the inside of the injured arm; the angle formed by the bend, which should be somewhat obtuse, being well pressed up into the axilla. In this way the limb is well steadied, and the tendency to displacement inwards of the lower fragment is corrected.

In some cases, fracture of the neck of the humerus is followed by atrophy of the bone, though good union has taken place.

Compound Fracture of the Surgical Neck of the Humerus is not of common occurrence. I have had a case under my care in which the accident happened to a lad from a fall out of a window. The fracture was transverse, and the upper extremity of the lower fragment was driven upwards, and protruded through the deltoid to the extent of an inch and a half. It was reduced with difficulty; as great irritation was set up around the seat of injury, and as there was a tendency to recurrent protrusion of the upper extremity of the lower fragment, this was turned out by enlarging the wound, and about an inch and a half of it sawn off. Union took place between the fragments, and recovery was effected with a very useful arm.

Separation of the Great Tubercle of the Humerus occasionally occurs from falls and blows upon the shoulder; but more commonly as the result of the violent action of the three external rotator muscles which are inserted into it. In this injury there is a double displacement; the tubercle is carried upwards and outwards away from the head of the bone, and under and external to the acromion process; the head is drawn upwards and inwards by the muscles passing from the trunk to the arm, as well as by the flexors of the arm, in such a way that it lies upon the inner edge of the glenoid cavity under the coracoid process, and is indeed almost luxated. The consequence of this double displacement is a great increase in the breadth of the shoulder, which has nearly double its natural size; on examination, a *rounded tumour*—the head of the bone—moveable on rotating the arm, can be felt under the coracoid process, whilst another osseous mass—the great

tubercle—may be felt at the outer and back part of the joint ; between these a sulcus is perceptible, and crepitus may be felt by bringing the two portions of bone into apposition and rotating the arm. This accident, which is of rare occurrence, has been most carefully described by Guthrie and Smith, to whom our knowledge of its pathology is due.

The principle of *Treatment* consists in an attempt to bring the detached tubercle into contact with the head of the bone, and retain it there ; this may be done either by mechanical means, or by relaxation of the muscles.

The treatment by mechanical means consists in placing a pad in the axilla, and bringing the elbow to the side so as to throw out the head of the bone, at the same time that, by means of a compress, the tubercle is pressed into proper position, the arm being supported in a sling. The treatment by relaxation of the muscles consists in elevating and extending the arm from the trunk ; in carrying this out, it is necessary that the patient be confined to bed, the arm being supported on a pillow.

Compound and Comminuted Fractures of the Head of the Humerus can only occur as a consequence of gun-shot injury. In these cases there may also be splintering of the acromion or coracoid processes, of the neck of the scapula or glenoid cavity, and possibly injury to the axillary vessels and plexus of nerves.

The *Treatment* must depend upon the extent of these complications. If the injury be chiefly confined to the head of the humerus, with little damage to the soft parts, and none to the main vessels or nerves, excision should be practised, any splinters in connection with the scapular processes being removed at the same time. Should, however, the soft parts be extensively disorganised, and especially the great vessels and nerves torn, amputation is the sole resource.

2. *Fractures of the Shaft of the Humerus* are usually somewhat oblique from above, downwards, and outwards. They may occur from any kind of external violence, but are more frequently the result of muscular action than those of any other bone. The nature of the accident can be at once detected by the great mobility of the fragment, the ready production of crepitus, and the other ordinary signs of fracture. The displacement usually consists in the lower fragment being drawn upwards and to the inner side of the upper one, which is often somewhat averted. The *Treatment* is of the simplest character ; flexing the elbow, bandaging the arm, and the application of two or three well-padded splints, the inner one of which should be rectangular, being all that is necessary. In applying a splint to the inner side of the arm, care must be taken that it do not press upon the axillary vein, lest gangrene of the limb occur.

3. *Fractures in the Vicinity of the Elbow-Joint* may occur through any of the osseous prominences in this situation. They are very commonly complicated with dislocation, with considerable contusion of and injury to the joint, or perhaps with comminution of the bones, and considerable laceration of the soft parts covering them. In most cases swelling speedily comes on, tending to obscure materially the nature of the injury. They may be classified as—*Separation of the Lower Epiphysis of the Humerus* ; *Transverse Fracture of the Lower End of the Bone* ; *Fracture of either Condyle* ; to which may be added *Fracture of the Olecranon*.

Separation of the Lower Epiphysis of the Humerus in children before its ossification is complete, is by no means an unfrequent accident ; the fragment being carried backwards, with the bones of the forearm connected with it, so as to cause considerable displacement posteriorly. It may readily be

replaced, but slips out of its position again, with crepitus, as soon as it is left to itself.

Transverse Fracture of the Lower End of the Humerus, just above the elbow, occasionally, but more rarely, occurs in adults. In these cases, the displacement backwards of the forearm and lower fragment, the pain, and crepitus, indicate the nature of the accident.

Fracture of either Condyle of the Humerus may arise from blows and falls



Fig 11. Transverse fracture of Condyles of Humerus.

on the elbow. There is considerable pain about the seat of the injury, but usually not much displacement; unless, as in Fig. 101, there be a transverse fracture as well. Crepitus, however, may readily be felt by rotating the radius, if it be the external condyle that is injured; or by flexing and pronating the forearm, if it be the internal condyle that has been detached.

The *Treatment* of all these injuries must be conducted on very similar principles. The swelling and inflammatory action, which rapidly supervene, usually require local antiphlogistic treatment, and the application of cold lotions, or of irrigation, the arm being flexed, and supported in an easy position on a proper splint. After the subsidence of the swelling, the fractured bone, whatever be the precise nature of the injury, is best maintained in position by being put up in angular splints; the forearm being kept in the mid state between pronation and supination, and well supported in a sling. It is in these particular fractures that passive motion, if it ever be employed, may be had recourse to, a tendency to rigidity about the joint being otherwise often left. The motion should be begun in adults at the expiration of a month or five weeks; in children, at the end of three or four weeks after the occurrence of the accident.

Compound and Comminuted Fractures of the Elbow-joint are necessarily serious accidents. They are commonly occasioned by falls on the point of the olecranon, which is the process of bone most frequently and extensively fractured. In some cases it will be found that the olecranon escapes injury, whilst the lower epiphysis of the humerus is splintered into many pieces; and more commonly, perhaps, both bones, ulna as well as humerus, are injured. As the integuments over the point of the elbow are thick and hard, very extensive comminution of the bones may occur with very little apparent lesion of the soft parts. When these fractures are the result of gun-shot injury, the soft parts may be extensively torn, and the bones greatly shattered. In the cases that occur in civil practice, I have seldom seen much laceration of the soft parts.

The *Treatment* of these important accidents will necessarily depend upon the amount of injury done both to bones and to soft parts. If the articulation be simply opened with little laceration of the surrounding soft parts, and no comminution of the fractured bone, the limb may very commonly be preserved by the employment of rest and active antiphlogistic treatment. If the bones be much shattered, the soft parts not being seriously implicated, removal of the splinters and resection of the injured joint will enable the surgeon to save the rest of the limb. But if the soft parts be extensively contused and torn, as well as the bones comminuted, amputation of the arm may be required. If recourse be not had to primary resection, abscess may form in front of or around the joint, with much constitutional disturbance, requiring the removal of the articular osseous extremities in

a few weeks, or possibly amputation of the limb. When resection is determined on, whether as a primary or as a secondary operation, the question may arise whether a partial or a complete removal of the articulation should be practised. In these cases, I am decidedly in favour of complete resection; any articular surface that is left covered with an incrusting cartilage interferes very materially with the deposit of lymph necessary for reparative action. Before this can take place, the cartilage must be removed by a process of disintegration, or necrosis of a tedious character, and attended by profuse suppuration. All this is avoided by the complete resection of all the articular surfaces, even where one only is injured. When primary resection is determined on, the sooner the operation is done the better; when a secondary operation is performed, the surgeon must wait until suppuration is fully established, and then he should do it with as little delay as possible, lest hectic or pyæmia supervene. The operative procedures necessary for the complete resection of a compound and comminuted fracture of the bones that enter into the conformation of the elbow-joint, differ in no material respect from the same operation as practised for disease of the articulation.

FRACTURES OF THE FOREARM.—1. The only fracture of the bones of the forearm that commonly occurs in the vicinity of the elbow-joint, is that of the *Olecranon*; this may happen from falls upon the elbow, or from muscular action. The displacement is usually considerable, the fragment which is detached being drawn upwards by the triceps muscle. Occasionally, however, when the ligamentary expansion of the tendon of this muscle is not torn through, there is but little separation of the fragments. In the majority of cases, as it takes place from direct violence, there is much swelling about the joint, and not unfrequently the fracture is compound. The *Treatment* may be conducted on two principles; by keeping the forearm either slightly flexed, or perfectly extended. I can see no advantage whatever in the partially flexed position, which must have a tendency to separate the fragments; whilst, in the extended position, by means of a light wooden splint applied along the whole of the arm, they come into good apposition, and may readily be maintained so by the pressure of a long strip of plaster drawn over the upper one.

In *Compound fracture of the olecranon*, when an attempt is made to save the joint, and when there is the possibility of ankylosis ensuing, the semi-flexed would be preferable to the straight position. In such cases, I have found it most comfortable to the patient to rest his arm slightly bent on a pillow.

Fracture of the Coronoid Process of the Ulna has been supposed by many surgeons to be a common complication, and, indeed, cause of dislocation of the ulna backwards. There is every reason, however, to believe that this is an error, and that, in point of fact, it is one of the rarest accidents in surgery—at least, we must come to this conclusion, if we are to judge by the small number of recorded cases or of preserved specimens of this injury. Mr Hamilton states that there are but eight cases on record in which the symptoms led to a belief that this accident had occurred; that in none of these cases were the symptoms unequivocal, but in all open to doubt; and that in not one case did dissection afford an opportunity of positively demonstrating this fracture. There are but four preparations in existence, according to Hamilton, illustrative of this injury, and all these, he says, are of a doubtful character. In the cases in which this accident has been supposed to have occurred, the injury has arisen from falls on the palm of the hand, by which the ulna has been driven backwards, and the coronoid process, striking against the lower end of the humerus, been splintered off. In a case related

by Liston, the injury is said to have been produced by muscular action in a boy, who, hanging for a length of time by his hands from a high wall, fell to the ground, and was supposed to have met with this fracture. Whether the fracture actually occurred in this case is doubtful, and if it did, it is still more doubtful whether it was occasioned by the contraction of the brachialis anticus, or by the violence of the fall.

In the present uncertain state of our knowledge, I forbear to speak of the supposed symptoms of this accident. If it were suspected, the proper treatment would consist in placing the limb in angular splints.

2. *Fractures of the Middle of the Forearm* are of very common occurrence, both bones being usually broken, with much shortening, angular displacement, and crepitus. Occasionally one bone only is fractured, from the application of direct violence. When this is the case, more attention will be required in establishing the precise nature of the injury.

The *Treatment* is simple; a splint somewhat broader than the arm should be placed on each side of it, and a narrow pad laid along the interosseous space, in order that the patency of this may be preserved; no bandage should be placed under the splint. If masses of callus happen to be thrown out across the interosseous space, the prone and supine movements of the hand will be lost, and the utility of the limb greatly interfered with.

Compound Fractures of the Forearm seldom give much trouble or require amputation, but they very commonly lead to obliteration of the interosseous space, and thus impair the after utility of the limb.

3. *Fractures of the Lower Extremity of the Radius*, near the wrist, are of very common occurrence. Their importance, not only in a diagnostic point of view, but also in reference to treatment, has caused them to be carefully studied by surgeons; and their nature and pathology have been specially investigated by Colles, Goyrand, Voillemier, Nélaton, and R. W. Smith.

These fractures usually occur from falls upon the palm of the hand, in consequence of which the lower end of the bone is bent back and drawn up; but they may be occasioned by direct violence, or by falls on the dorsum, so that the hand is forcibly bent forwards. In this accident the radius is always broken across transversely, usually from three quarters to one inch above its articular surface. The fracture may be of three kinds; 1, a simple transverse one; 2, with comminution of the lower fragment; and, 3, with firm impaction of the upper into the lower fragment.

The *Signs* of this accident vary greatly, according to its nature. When *simple*, there is usually no very great displacement; but there will be noticed some tumefaction about the wrist, a swelling at its dorsal aspect, loss of the movement of the radius, and crepitus on rotating the bone, whilst the hand is drawn down. When the fracture is *comminuted*, and still more so when *impacted*, the signs are very marked and characteristic; so much so, that they may always be looked upon as diagnostic of these forms of this accident. The deformity thus occasioned gives rise to a remarkable undular distortion of the wrist. On looking at the injured limb sideways, it will be seen that there is a considerable dorsal prominence apparently situated on the back of the carpus (Fig. 102); immediately underneath this, on the palmar aspect of the wrist, just opposite the annular ligament, there is a remarkable hollow or arch most distinctly marked at, and indeed confined to, the radial side of the arm; a little above this, that is to say, on the lower part of the palmar aspect of the forearm, there is another rounded prominence, not nearly so large or distinct, however, as the one on the dorsal aspect. On looking at the back of the hand, it will be seen to be placed somewhat obliquely to the axis of the forearm; the ulnar border being somewhat convex, and the

styloid process of the ulna projecting sharply under the skin (Fig. 103).



Fig. 102 - Fracture of Lower End of Radius: Side View.

The radial side of the wrist is, on the contrary, somewhat concave, appearing to be shortened.

The pain about the seat of injury is very severe, and is greatly increased by moving the hand, especially by making any attempt at supination. The hand is perfectly useless, the patient being unable to support it. All power of rotating the radius is lost, the patient moving the whole of the arm from the shoulder at once, and thus apparently, but not really, pronating and supinating it. Crepitus can readily be felt when the fracture is simple or comminuted; but when it is impacted, the most careful examination fails to elicit it.

The Cause of the particular Deformity that is observed, and indeed the general pathology of the injury, has been the subject of much discussion, in a great measure owing, I believe, to the opportunities of dissecting recent fractures of this kind being not very frequent. Surgeons are, however, now generally agreed that the dorsal prominence is due to the lower fragment, carrying the carpus with it, being displaced backwards and upwards; whilst the palmar tumefaction is due to the projection forwards of the lower end of



Fig. 103 - Fracture of Lower End of Radius: Back View.



Fig. 104 - Fracture of Lower End of Radius: Displacement of Lower Fragment.

the upper fragment, which is thrown into a state of forcible pronation. There is thus a double cause of displacement in operation. The displacement of the upper fragment is evidently owing to the pronatores quadratus and teres; but to what is the displacement of the lower fragment due? Is it to the peculiar manner in which the two fragments are locked into one another? or is it due to muscular action? Some years ago I had an opportunity of dissecting and carefully examining the state of the limb in a woman who died of paralysis in University College Hospital, twelve days after meeting with this accident. On examining the left arm, which presented all the signs of this injury in a marked



Fig. 105 - Fracture of Lower End of Radius: Displacement of Lower Fragment.

degree, and from which Fig. 104 was taken, a transverse fracture of the radius was found about an inch above its articular surface. The lower fragment was split into three portions, between which the upper fragment was so firmly impacted to the depth of more than half an inch, as to require some force in its removal. The three portions into which the lower fragment was split

were of very unequal size ; the two posterior ones being small, consisting merely of scales of bone ; the third fragment, the largest, comprising the whole of the articular surface of the radius, which was somewhat tilted upwards and backwards, carrying the hand with it. To this fragment were attached the supinator longus, and the greater part of the pronator quadratus ; the ligaments and the capsule of the joint were uninjured.

This case presented the appearances usually met with in this kind of injury ; the lower fragment being displaced in such a way that its articular surface looked slightly upwards, backwards, and somewhat outwards, so as to be twisted as it were upon its axis. The upper fragment was found in a state of pronation, and was driven into and firmly impacted in the lower one.

That the deformity in this case was the result of impaction there could be no doubt ; and that impaction is the cause of deformity in many cases, is proved by an examination of several specimens of consolidated fracture of the radius preserved in the different collections in London, and by the difficulty of accounting in any other way for the occasional impossibility of properly reducing these fractures. The great traction that is usually required to remove the deformity, and the absence of distinct crepitus, until after forcible traction has been employed, indicate the existence of this impaction.

The mode in which the impaction and consequent deformity occur, appears to me to be as follows. When a person falls on the palm of the hand, the shock, which is principally received on the ball of the thumb and the radial side of the wrist, is not directed immediately upwards in the axis of the radius ; but the force, impinging in a direction obliquely from before backwards, and from without inwards, as well as from below upwards, has a tendency to rotate the lower fragment on its own axis, and to tilt the articular surface somewhat upwards and outwards. As the upper fragment descends, its posterior surface of compact tissue is forced into the cancellous structure of the lower fragment, to such a depth as will admit of the two anterior portions of compact tissue coming into contact ; and thus the upper line of compact tissue is driven into the lower fragment, to an extent corresponding to the degree with which the fragment is rotated upwards and backwards. If the bone be brittle, or the force be continued after this amount of impaction has taken place, the lower fragment will be splintered.

The prominence of the styloid process of the ulna is the result of the shortening of the radial side of the wrist and hand, consequent upon the impaction.

When the fracture is simple, or when it is comminuted without impaction, I agree with R. W. Smith that the displacement of the lower fragment is the result of muscular action. This I have had an opportunity of observing in the following case. A man, 64 years of age, fell to the ground from a height of twenty-five feet. In his fall he broke the left radius just above the wrist, but also met with such serious injuries about the pelvis and abdomen, that he died in an hour after admission into the hospital. On dissecting the arm carefully about twenty-four hours after death, I found that the radius was fractured transversely about half an inch above its lower articular end, and that the lower fragment was completely comminuted. The wrist, which presented all the signs of this fracture in a very marked, but not an extreme degree, could not be restored to its normal shape by any amount of traction that I could employ. On exposing the muscles of the limb, it was found that the supinator longus was attached to the lower, and the pronator quadratus to the upper fragment ; the latter muscle being slightly lacerated at its lower part. The upper fragment was strongly pronated. The distal

in the deformity can be produced. When it is mobile, it may usually be brought into good position. The fracture unites in the course of a month or five weeks. Passive motion of the joint may, however, often be commenced at an earlier period than this, with great advantage to the patient, more particularly when the fracture is impacted. It will be at least three months before the stiffness of the hand and wrist are so far diminished, even by the use of friction and douches, as to enable the patient to use the fingers. It sometimes happens that in both arms the radius is broken at the same time in this situation, constituting a somewhat serious condition, inasmuch as the patient is not able to feed or assist himself in any way during the treatment.

FRACTURES OF THE METACARPUS AND FINGERS are of so simple a character in every way as scarcely to call for detailed remarks. In the *Treatment*, rest of the part upon a leather or pasteboard splint is all that is requisite. In compound fracture of these bones, every effort should be made to save the part; if removal become necessary, it should be to as limited an extent as possible (p. 37).

FRACTURES OF THE LOWER EXTREMITY.

FRACTURES OF THE PELVIS.—The danger here depends not so much on the extent of the fracture as on its complication with internal injury, and on the violence with which it has been inflicted. Fracture may extend in any direction across the pelvic bones, though most commonly it passes through the rami of the os pubis and ischium, and across the body of the ilium, near the sacro-iliac articulation. In some cases the symphysis is broken through, and in others the fracture extends across the body of the pubic bone.

It occasionally happens that a portion of the crest of the ilium is broken off; but this is of little consequence, even though the bone continue depressed. When the rami of the os pubis and ischium, or the whole body of the ilium, are broken through, there is, of course, considerable danger from internal injury. If the patient escape this, the fracture, however extensive it may be, may unite favourably. I had a patient under my care at the hospital, with a fracture extending through the rami of the os pubis and ischium, and across the ilium, in a line parallel with and close to the sacro-iliac symphysis, so as completely to detach one half of the pelvis; he recovered, however, without any bad consequences occurring.

The nature of the injury is usually apparent from the great degree of direct violence that has been inflicted upon the part; from the pain that the patient experiences in moving or in coughing; from the impossibility to stand, in consequence of a feeling as if the body were falling to pieces when he attempts to do so; and from the ready mobility of the part and crepitus on seizing the brim of the pelvis on each side and moving it to and fro, or on rotating the thigh of the affected side. In examining a patient with suspected fracture of the pelvis, care should, however, be taken not to push the investigation too closely, lest injury be inflicted by the movement of the fragments. In those cases, indeed, in which the fracture does not extend completely across the pelvis, or in which it is seated in the deeper parts of the ischium, an exact diagnosis may be impossible.

In fractured pelvis, the principal sources of danger arise from injury to the bladder and urethra, with consequent extravasation of urine; from laceration of the rectum, or fracture of the acetabulum; and in examining the pelvis no rough handling should be allowed, lest injury to the pelvic organs be inflicted by the fragments.

In the *Treatment*, the first thing to be done is to pass a catheter into the bladder, in order to ascertain the condition of the urinary apparatus; if a

Surgeons. These fractures are almost invariably transverse, with displacement forwards of the upper margin of the lower fragment. This was the case in the instance under my care; but Richerand has published a case in which this bone was split vertically in consequence of a fall on the face, and its crucial and multiple fracture has been described by others. It can necessarily only arise from direct violence of a severe character, attended by much extravasation and pain, together with neuralgia along the course of the posterior sacral nerves, which may be implicated in or irritated by the fracture. The *Treatment* would consist in the application of a padded pelvic band.

THE COCCYX, though more exposed, is seldom broken. But fracture of it may occur from falls backwards, or from direct blows on the part, the tip being bent forcibly forwards, and the elements of the bone separated. The pain in these cases is excessively severe, owing to the bruising of the ligamentous and tendinous expansions that cover the bone. It is greatly increased in sitting and walking, and in defecation. It is sometimes removed on reducing the fractured and displaced fragments by pressure through the rectum, but may continue for months, and even longer, constituting a truly neuralgic affection of the part. South relates the case of a gentleman who broke his coccyx by sitting on the edge of a snuff-box, and who suffered such severe pain that he was obliged to wear a pad on each tuberosity of the ischium, in order that the coccyx might be in a kind of pit, and free from all pressure when he sat.

Under the term *Coccydynia*, Dr. Simpson has described a painful affection of the coccyx and its neighbouring structures, which chiefly occurs in women, commonly as the result of injury, and is often of a very severe and persistent character, so as to prevent the patient from sitting, or even walking with comfort. It is an affection that closely resembles in its symptoms the pain occasioned by fissure or ulcer of the anus and rectum. It usually arises from a blow on the part, though it appears sometimes to originate independently of any external violence. The *Treatment* recommended by Dr. Simpson consists in the free subcutaneous division, by means of a tenotome, of the muscular and tendinous structures connected with the coccyx. The section of these structures is made first on one side, then on the other, and finally around the tip, so as completely to isolate the bone. The good effects of the operation are usually immediate, the pain ceasing at once.

FRACTURES OF THE THIGH-BONE are of great practical interest, from their frequency and severity. They may occur in the Upper Articular End of the bone, in its Shaft, or in its Lower End. In these different situations every possible variety of fracture is often met with.

1. Fractures of the pelvic end of the bone may be divided into those that occur *through the neck within the capsule* of the joint, those that occur *outside the capsule*, and those that implicate the trochanter alone.

Intracapsular Fractures of the Neck of the Thigh-Bone are of two kinds; the *simple*, in which the bone is merely broken across; and the *impacted*, in which the lower portion of bone is driven into the upper fragment.

This intracapsular fracture may almost be looked upon as a special injury of advanced life, being but seldom met with in persons under fifty. Thus Sir A. Cooper states that, of 251 cases with which he met in the course of his practice, only two were in persons below this age. It may, however, happen at an early period of life. Thus, Mr. Stanley has recorded the case of a lad of eighteen, who met with this injury. Another remarkable circumstance in connection with it is, that it commonly happens from very slight degrees of violence, indeed almost spontaneously. Thus, the jarring

cause of displacement, and the main obstacle to reduction, was found to exist in the two radial extensors of the wrist, the tendons of which were excessively tense, next to these, the special extensors of the thumb presented most tension, and then the supinator longus, which was far less tense than either of the other sets of muscles, but especially than the radial extensors, the tendons of which were strongly defined. On dividing these tendons, and on pressing the lower end of the upper fragment outwards, reduction was easily effected. Here the displacement was evidently due to two causes. The upper fragment was forcibly pronated by the action of its special pronators; and the hand, with the lower fragment attached, was drawn upwards and backwards by and in the direct line of the radial extensors of the wrist. There was no impaction nor interlocking of fragments, but perfect mobility, and hence muscular action was enabled to come into play.

Besides this injury, R. W. Smith has described a fracture of the lower end of the radius in consequence of falls upon the back of the hand, in which the inferior fragment is displaced forwards. In these cases the character of the deformity indicates the nature of the injury. It can readily be reduced, with a feeling of crepitation, by traction.

In another variety of fracture in this situation, the lower end of the radius and that of the ulna are broken off, resembling very closely dislocation of the wrist backwards. But the facts of the existence of grating, of the ready reduction of the swelling, and of the styloid processes of the radius and of the ulna continuing to be attached to the carpus, and following its movements, will be sufficient to establish the diagnosis.

The *Treatment* of the ordinary fracture of the radius near the wrist is best conducted by the apparatus introduced by Nélaton (Fig. 106). This consists

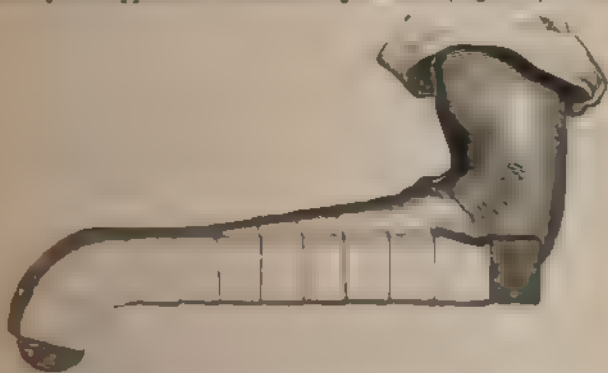


FIG. 106.—Nélaton's Apparatus for Treatment of Fracture of the Lower End of the Radius.

of a pistol shaped wooden splint, which is placed along the outside of the arm, reaching from the elbow to the extremity of the fingers. forcible extension and counter-extension should be practised with the view of disentangling the fragments, and removing the dorsal prominence. The splint, already padded opposite the lower fragment, should then be applied to the outer side of the arm; and the hand, being well brought down to its ulnar side, should be bandaged to the bent part of the splint. Another short splint, reaching from the bend of the elbow to the lower extremity of the upper fragment, should now be placed along the inside of the arm, after having been well padded along its radial border, so as to counteract the tendency to pronation of this part of the bone. The arm must then be placed in a sling. When the fracture is impacted, little, if any, alteration

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1. Fractures of the pelvic end of the bone may be divided into those that occur *through the neck within the capsule of the joint*, those that occur *outside the capsule*, and those that implicate the *trochanter alone*.

Intracapsular Fractures of the Neck of the Thigh-Bone are of two kinds: the *simple*, in which the bone is merely broken across; and the *compound*, in which the lower portion of bone is driven into the upper fragment.

This intracapsular fracture may almost be looked upon as a disease of advanced life, being but seldom met with in persons under 40. Sir A. Cooper states that, of 251 cases with which he was conversant in his practice, only two were in persons below 40. It is more apt to happen at an early period of life. Thus, M. Blandin relates the case of a lad of eighteen, who met with this fracture under the following circumstance in connection with it is, that it occurred after slight degrees of violence, indeed almost any

be injured, recourse must be had to measures that will be hereafter described. The next thing is to keep the part perfectly quiet, so as to bring about union. With this view, a padded belt, or a broad flannel roller, should be tightly applied round the pelvis, the patient lying on a hard mattress. The knees may then be tied together, and a leather or gutta-percha splint put upon the hip of the side affected, so as to keep the joint quiet, and to prevent all displacement of the fragment.

Fracture of the Acetabulum is an accident that can only occur as the result of very great violence directly applied to the hip. It may take place in two situations; either through the floor of the cavity, or only through the rim, a portion of which is detached. It is probably occasioned in most instances by the head of the bone being driven forcibly against the surface of the acetabulum. Hence, when the rim is broken, it is usually the posterior part that is detached, and the head of the femur slips out upon the dorsum ili.

Fracture through the floor of the acetabulum is usually complicated with extensive comminution of the pelvic bones and serious internal injury, so as to be followed by death. In the University College Museum is a preparation of a fracture of the acetabulum, with comminution of its floor and of the ilium. Sanson and Sir A. Cooper have seen the bone resolved into its three primitive fragments; and in some cases the comminution has been so great that the head of the femur has been thrust into the pelvic cavity.

In such extensive and grave injuries as these, the surgeon can do little more than support the pelvis with a padded belt, and place the limb on the long splint.

When a portion of the rim of the acetabulum is detached, as the result of direct violence, the head of the femur will slip out upon the dorsum ili, or into the sciatic notch, and the signs of ilio-sciatic dislocation manifest themselves. In a case of this kind, which was under my care at the hospital in a muscular man about thirty, the shortening, inversion, and displacement of the head of the bone into the sciatic notch, were all well marked and unequivocal. Traction readily effected reduction, with distinct crepitus; but, as soon as extension was discontinued, the head of the bone slipped back into the sciatic notch.

The diagnosis in this case was made, and in similar instances may readily be effected, by attention to three circumstances:—the dislocation, its ready reduction with crepitus, and its immediate return when the limb is left to itself.

The *Treatment* consists in the application of the long splint with a broad padded belt, so as to secure steadiness of the head of the bone. But with every care a return of displacement will readily take place, and an unsatisfactory result can scarcely be avoided; shortening of the limb, and consequent lameness, being almost inevitable.

FRACTURES OF THE SACRUM are excessively rare, except as the result of gun-shot injury. When occurring from other causes, such as falls, they are almost invariably associated with fracture of the pelvic bones, and then they have always been fatal. The records of surgery contain but a very few observations, probably not more than six or eight, of uncomplicated fracture of the sacrum arising from other causes than gun-shot. I have had two cases of fracture of the sacrum under my care. Both had a rapidly fatal issue. In one there was also fracture through the pubic bone; in the other, the sacrum was the only bone injured. In it, the fracture was the result of a blow on the lower part of the back by the buffer of a railway carriage. The preparation is in the University College Museum. The only other preparation with which I am acquainted, is one in the Museum of the College of

occurrence, there being in all probability not more than eighteen or twenty cases on record as having thus terminated in this country. When bony union has taken place, the head will usually be found to be somewhat twisted round in such a way that it looks towards the lesser trochanter, owing to the eversion that has taken place in the lower fragment.

Treatment.—As these fractures do not unite by bone, unless the fragments be in good contact, it is useless to confine the patient to bed for any long period, if the signs, especially the amount of *shortening*, indicate considerable separation between the fragments, or if the patient be very aged and feeble. Under these circumstances, lengthened confinement to bed most commonly proves fatal by the depressing influence it exercises on the general health, by the intercurrent of visceral disease, or by the supervention of bed-sores. It is therefore a good plan to keep the patient in bed merely for two or three weeks, until the limb has become somewhat less painful, the knee being well supported upon pillows. After this time, a leather splint should be fitted to the hip, and the patient be allowed to get up upon crutches. There will be lameness during the remainder of life; but, with the aid of a stick and properly adjusted splint, but little inconvenience will be suffered.

When the fragments do not appear to be much separated, there being but little shortening and indistinct crepitus, and more particularly if the patient be not very aged, and in other respects sound and well, an attempt may be made to procure osseous union. This may be done by the application of the long thigh-splint; or, if this cannot very readily be borne, by the double inclined plane, with a padded belt strapped round the hips. This apparatus should be kept applied for at least two or three months, when a leather splint may be put on and the patient be got upon crutches. During the whole of the treatment, a generous, and even stimulating diet should be ordered, and the patient kept on a water-bed or cushion. In these fractures of the neck of the femur, the starched baudage will often be found to be most useful. It may be applied as in fractured thigh, but should have additional strength in the spica part, and indeed may be provided with a small pasteboard cap so as to give more efficient support. In old people, this plan of treatment is especially advantageous, as it enables them to sit up or even to walk about, and thus prevents all the ill effects of long confinement in bed.



FIG 108.—*Extracapsular Fracture of the Neck of the Femur.* Detachment of the Trochanter, and the upper end of the shaft injured (Fig. 108). This splintering of the

Extracapsular Fracture of the Neck of the Thigh-Bone is commonly met with at an earlier period of life than the injury which has just been described, being most frequent between the ages of thirty and forty. It is the result of the application of great and direct violence upon the hip, and occurs equally in both sexes.

This fracture may be of two kinds; the *simple*, or the *impacted*. In both cases the neck of the bone is commonly broken at, or immediately outside, the insertion of the capsule of the joint. The fracture is almost invariably comminuted; indeed, I have never seen a case in which the great trochanter was not either detached or splintered into several fragments. In many instances the lesser trochanter is detached,

of the foot in missing a step in going down stairs, catching the toes under the carpet, tripping upon a stone, or entangling the foot in turning in bed, are sufficient to occasion it. It is especially in women that this injury is met with.

Cause.—The occurrence of this fracture in old age is owing indirectly to the changes in structure, shape, and position of the head and neck of the femur with advancing years. The cancellous structure of these parts becomes expanded, the cells large, loose, and loaded with fluid fat. The compact structure becomes thinned, and proportionately weakened, especially about the middle and under part of the neck, which, appearing to yield to the weight of the body, is shortened; and, instead of being oblique in its direction, becomes horizontal, inserted nearly at a right angle into the shaft. In consequence of these changes in structure and position, it becomes less able to bear any sudden shock by which the weight of the body is thrown upon it, and snaps under the influence of very slight degrees of violence. When it breaks, the capsule may remain uninjured, but the prolongation of it which invests the neck of the bone is usually torn through. In some cases, however, this cervical reflexion is not ruptured, the lower portion of it especially often remaining for some length of time untorn, at last, however, giving way under the influence of the movements of the limb, or by being softened by local inflammatory action. As the violence occasioning the fracture is generally but slight, and as the vascularity of this portion of the bone is trifling in old people, there is but little extravasation of blood.

The fragments are almost always so separated that the fractured surfaces are not in apposition: the upper end of the lower fragment is drawn above and to the outer side of the head of the bone, and at the same time is twisted so that its broken surface looks forwards. The head remains in the acetabulum, attached by the ligamentum teres, and sometimes preserving a connection with the lower fragment, through the medium of some untorn portions of the fibrous membrane investing the neck. The capsule is uninjured.

Dr. R. W. Smith has observed, that in some instances the two fragments become interlocked or dovetailed as it were into one another, in consequence of the line of fracture being irregular and dentated.

Signs.—These are, alteration in the shape of the hip, crepitus and pain at the seat of injury, and inability to move the limb, with shortening and eversion of it. These we must consider separately, as important modifications of each are sometimes noticed.

The alteration in the shape of the hip is evidenced by some flattening of the part, the trochanter not being so prominent as usual. This process is also approximated to the anterior superior spine of the ilium; and, on rotating the limb, it is felt to move to and fro under the hand, not describing the segment of a circle so distinctly as on the sound side. The circle described by the trochanter on the injured side is much smaller than that on the sound side. In the sound limb, the trochanter describes the segment of a circle having a radius equal to the length of the head and neck of the bone. On the injured side, the circle has a radius equal only to the length of that portion of the neck that still remains attached to the shaft of the bone. During this examination crepitus will usually be felt, though this occasionally is very indistinct and even absent, more especially if the limb be not well drawn down at the time it is rotated, so as to bring the fractured surfaces into apposition; and much pain is experienced by the patient on any movement of, or pressure upon, the joint.

The attitude of the limb is so peculiar, as in general to indicate at once to

the surgeon what has happened. There is an appearance of helplessness about it that is striking. As the patient is lying on his back in bed it is everted,



Fig 17. Intracapsular Fracture of the Neck of the Thigh-Bone

shortened somewhat, with the knee semi-flexed, on requesting him to lift it up, he makes ineffectual attempts to do so, and at last ends by raising it with the toe of the opposite foot, or with his hands. When he is taken out of bed and placed upright, the injured limb hangs uselessly, with the toes pointing downwards, and the heel raised and pointing to the inner ankle of the sound side, the patient being unable to rest upon it (Fig. 107). In some cases, however, it happens that, after the fracture has occurred, the patient can lift the limb somewhat, but with much exertion, from the couch on which he is lying; or can even manage to walk a few paces, or to stand for a few minutes upon it, with much pain and difficulty. This is owing either to the cervical reflexion of the capsule being untorn, or else to the fragments not being separated, having become locked into one another; and it usually occurs in those cases in which the other and more characteristic signs of this fracture are not well marked.

Eversion of the limb is almost an invariable accompaniment of this fracture. It is most marked in those cases in which the shortening is most considerable. This eversion has usually been attributed to the action of the external rotator muscles, which are inserted into the upper end of the lower fragment. But I cannot consider this as the only, or indeed the principal cause, of this position; for, not only is it very difficult to understand how these muscles can rotate outwards the limb after their centre of motion has been destroyed by the fracture of the neck of the femur, their action being rather in a direction backwards than rotatory under these circumstances, but we find that the limb falls into an everted position in those cases in which, the fracture being in the shaft, and altogether below the insertions of these muscles, no influence can be exercised by them on the lower fragment. I look upon eversion in cases of fractured thigh as not being a muscular action at all, but simply the natural attitude into which the limb falls when left to itself. Even in the sound state, eversion takes place spontaneously whenever muscular action is relaxed, as during sleep, in paralysis, or in the dead body; and in the injured limb, in which there is, as it were, a suspension of muscular action, it will occur equally. Indeed, the shortening that takes place will specially tend to relax the external rotators, and thus still more prevent their influencing the position of the limb.

Inversion of the foot in cases of intracapsular fracture has been noticed in a few cases. I have seen one instance of this: Smith, Stanley, and other surgeons, also record cases. The cause of this deviation from the usual symptoms of this injury has been a good deal discussed. It has been attributed by some to the cervical ligament not having been torn through at its inner side, but that, as Stanley observes, may prevent eversion, but cannot occasion inversion; by others to the fact of the lower fragment in these cases being always found in front of the upper one. This circumstance, which is much insisted on by R. W. Smith, appears to me to be rather the result than the cause of the inversion; for any rotation inwards of the lower

fragment by the adductor muscles of the thigh would have a tendency to draw the upper end of this fragment to the anterior, or in other words, the inner side of the upper one. I am rather disposed to think that this inversion is owing, in some cases at least, to the external rotators being paralysed by the violence they receive from the injury that occasions the fracture, and that thus the adductors, acting without antagonists, draw the thigh and leg forward. In the instance that fell under my observation, and in some of those that have been published, the fracture resulted from direct injury to the hip, and was not occasioned by the patient jarring his foot, or by any indirect violence operating at the end of the limb.

The shortening in cases of fracture within the capsule seldom exceeds, in the first instance, from half an inch to an inch, depending on the extent of the separation between the fragments; it cannot, indeed, in the early periods of the fracture, very well exceed the width of the neck of the bone, as the capsule is usually not torn through. After the fracture has existed some time, the capsule of the joint may yield, allowing greater separation between the fragments, and then it may amount to two, or even two-and-a-half inches. It not uncommonly happens that the shortening, which is at first but very slight, about half an inch, suddenly increases to an inch or more; this is accounted for on the supposition of the cervical ligament, which had at first not been completely ruptured, at last giving way entirely; or it may be owing to the fragments which were originally interlocked becoming separated. It is in those cases in which there is but slight separation of the fragments, and consequently little shortening, that the other signs of fracture are not very strongly marked, and that the patient preserves some power over the movements of the limb.

The *Constitutional Disturbance* in intracapsular fracture of the neck of the femur in old people, though trifling at first, often eventually becomes considerable; and the injury frequently terminates fatally, from the supervention of congestive pneumonia, an asthenic state of system, or sloughing of the parts from confinement to bed during treatment. Hence this injury must always be considered as one of a very dangerous, and not unfrequently fatal character.

Mode of Union.—The treatment of these fractures turns in a great measure upon the view that is taken of their mode of union, and on the constitutional condition of the patient. In some cases no union occurs, but the head of the bone remains in the acetabulum, being hollowed into a smooth, hard, cup-shaped cavity, in which the neck, which has become rounded off and polished, is received, and plays as in a socket.

The union of the intracapsular fracture of the neck of the femur takes place, however, in the great majority of cases by fibrous tissue. This is owing to two causes; in the first place, to the circumstance (which I look upon as the most important) that the fractured surfaces are not in apposition with one another; and secondly, that the vascular supply sent to the head of the bone, consisting only of the blood that finds its way through the vessels of the ligamentum teres, is insufficient for the proper production of callus.

In some cases, however, bony union takes place. This can only happen when, in consequence of the cervical ligament being untorn, or the fracture being impacted, the surfaces are kept in some degree of apposition, and the vascular supply to the head of the bone is speedily augmented by the blood carried into it through the medium of the plastic matter that is deposited between the fragments. Under no other circumstance is it probable that bony union takes place in these fractures: hence the infrequency of it.

occurrence, there being in all probability not more than eighteen or twenty cases on record as having thus terminated in this country. When bony union has taken place, the head will usually be found to be somewhat twisted round in such a way that it looks towards the lesser trochanter, owing to the eversion that has taken place in the lower fragment.

Treatment.—As these fractures do not unite by bone, unless the fragments be in good contact, it is useless to confine the patient to bed for any long period, if the signs, especially the amount of *shortening*, indicate considerable separation between the fragments, or if the patient be very aged and feeble. Under these circumstances, lengthened confinement to bed most commonly proves fatal by the depressing influence it exercises on the general health, by the intercurrent of visceral disease, or by the supervention of bed-sores. It is therefore a good plan to keep the patient in bed merely for two or three weeks, until the limb has become somewhat less painful, the knee being well supported upon pillows. After this time, a leather splint should be fitted to the hip, and the patient be allowed to get up upon crutches. There will be lameness during the remainder of life; but, with the aid of a stick and properly adjusted splint, but little inconvenience will be suffered.

When the fragments do not appear to be much separated, there being but little shortening and indistinct crepitus, and more particularly if the patient be not very aged, and in other respects sound and well, an attempt may be made to procure osseous union. This may be done by the application of the long thigh splint; or, if this cannot very readily be borne, by the double inclined plane, with a padded belt strapped round the hips. This apparatus should be kept applied for at least two or three months, when a leather splint may be put on and the patient be got upon crutches. During the whole of the treatment, a generous, and even stimulating diet should be ordered, and the patient kept on a water-bed or cushion. In these fractures of the neck of the femur, the starched bandage will often be found to be most useful. It may be applied as in fractured thigh, but should have additional strength in the spica part, and indeed may be provided with a small pasteboard cap so as to give more efficient support. In old people, this plan of treatment is especially advantageous, as it enables them to sit up or even to walk about, and thus prevents all the ill effects of long confinement in bed.

Extracapsular Fracture of the Neck of the Thigh-Bone is commonly met with at an earlier period of life than the injury which has just been described, being most frequent between the ages of thirty and forty. It is the result of the application of great and direct violence upon the hip, and occurs equally in both sexes.

This fracture may be of two kinds; the *simple*, or the *impacted*. In both cases the neck of the bone is commonly broken at, or immediately outside, the insertion of the capsule of the joint. The fracture is almost invariably comminuted; indeed, I have never seen a case in which the great trochanter was not either detached or splintered into several fragments. In many instances the lesser trochanter is detached, and the upper end of the shaft injured (Fig. 108). This splintering of the

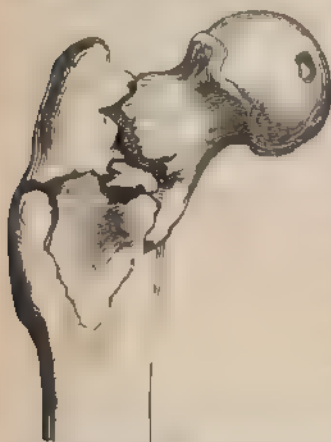


Fig. 108.—Extracapsular Fracture of the Neck of the Thigh Bone. Detachment of the Trochanter.

and the upper end of the shaft injured (Fig. 108). This splintering of the

trochanter is owing to the same violence that breaks the bone forcing the lower end of the neck into the cancellous structure of this process, and thus, by a wedge-like action, breaking it into fragments. When the neck continues locked in between these, we have the impacted form of fracture.

The *Signs* of extracapsular fracture vary according as it is simple or impacted, but in both cases they partake of the general character of those that are met with in fractures within the capsule. The individual signs, however, differ considerably from these.

The hip will usually be found much bruised and swollen from extravasation of blood, which is often considerable. The *crepitus* is very distinct and loud, being readily felt on laying the hand upon the trochanter, and moving the limb. The separate fragments into which the trochanter is splintered may occasionally be felt to be loose. The *pain* is very severe, and greatly increased by any attempt at moving the joint, which to the patient is impossible.

The *eversion* is usually strongly marked, and the position of the limb is characteristic of complete want of power in it. *Inversion* occurs more frequently in this fracture than in that within the capsule. Smith finds that of 7 cases of inversion of the limb in fractures of the neck of the femur, 5 occurred in the extracapsular fracture; and of 15 cases of extracapsular fracture, this condition was met with in 3. When there is much comminution of the trochanter, the foot will commonly remain in any position in which it is placed, but generally has a tendency to rotate outwards.

The *shortening* of the limb is very considerable, being never less than from an inch and a quarter to two inches and a half, and often extending to three or four inches.

The *impacted extracapsular fracture* of the neck of the thigh-bone occurs when the upper fragment is driven into the cancellous structure of the lower one, remaining fixed there (Fig 109). The signs of this form of fracture are often of a somewhat negative character, rendering its diagnosis and detection extremely difficult. There is pain about the hip, with slight eversion of the foot, and some shortening, usually amounting to about half an inch, but never exceeding one inch. There is but little crepitus—in some cases none can be detected, and the patient can then raise the foot for a few inches off the couch on which it is laid, and even walk upon it with a trudging motion, though with much pain. In consequence of the impaction the limb cannot be restored by traction to its proper length, and hence incurable lameness always results from this injury.



Fig 109.—Impacted Extracapsular Fracture of Neck of Thigh Bone.

The *Distinctions* of the different forms of fracture of the neck of the thigh-bone from one another, and from other injuries occurring in the vicinity of the hip-joint, is a matter of considerable importance, and often of no slight difficulty. Between the intracapsular and the ordinary extracapsular fractures there can be no difficulty, all the signs of the latter being so much more strongly marked than those of the former injury, the difference of age and the degree of violence required to break the bone being also important elements in the diagnosis, as may be seen by the annexed Table:

Diagnosis between Intra- and Extracapsular Fractures of the Neck of the Thigh-bone.

Intracapsular.

1. Cause generally slight and indirect, such as entering the foot in the carpet or slipping off the curb stone.
2. Age, rarely below fifty, most commonly in feeble aged persons.
3. Pain and constitutional disturbance slight.
4. No apparent injury to soft parts about hip.
5. Crepitus often obscure.
6. Shortening usually at first not more than one inch.

Extracapsular.

1. Cause usually severe and direct violence, such as falling from a height or blow on hip.
2. Age, usually below fifty; chiefly in vigorous adults.
3. Pain and constitutional disturbance usually considerable.
4. Considerable extravasation, ecchymosis, and signs of direct injury to hip.
5. Crepitus (when not impacted) very readily felt.
6. Shortening (when not impacted) at least two inches or more.

It is more difficult to distinguish between the *intracapsular* fracture and the *impacted extracapsular fracture*. In the former case, however, the crepitus and eversion are more marked, and the injury usually occurs from less direct violence than when the fracture is outside the capsule. In the latter case, also, traction cannot restore the limb to its proper length as in the former instance.

In *severe contusions of the hip* there is sometimes eversion of the limb with inability to move it, so that at first sight it might be supposed that the bone was broken. In these cases, however, the absence of shortening and crepitus will always establish the diagnosis. The difficulty is greater, however, in those instances in which, the hip-joint having been the seat of *chronic rheumatic arthritis*, the limb is already somewhat shortened; here, however, the history of the case, and the fact of the shortening not being of recent occurrence, will be sufficient to establish the nature of the injury. The diagnosis of these injuries from *dislocations* will be considered in a subsequent chapter.

In the *extracapsular fracture of the neck of the femur*, death not uncommonly results from the severity of the injury, the pain and irritation of the fracture, and the consequent shock to the system. The great extravasation of blood into the tissues of the limb has been known to be sufficient to account for the fatal result. When the patient lives, bony union takes place, large irregular stalactitic masses being commonly thrown out by the inferior fragment, so as to overlap the several splinters of bone. Thus callus is most abundant posteriorly in the intertrochanteric space (Fig. 110).



Fig. 110. — Extracapsular Fracture of Neck of Thigh Bone. Abundant Formation of Callus.

The *Treatment* of the extracapsular fracture may very conveniently and efficiently be conducted by means of the long splint, a padded belt, if necessary, being strapped firmly round the hip underneath it; or the plan recommended by Sir A. Cooper, of placing the patient on a double inclined plane, with both feet and ankles tied together, and a broad belt, well-padded, firmly strapped round the body, so as to press the fragments of the trochanter firmly against one another, will be found an excellent mode of keeping the limb of a proper length, and the fragments in contact.

Occasionally the fracture extends through the trochanter major without implication of the neck of the bone. Here there is shortening to about three-fourths of an inch, or an inch, with much eversion and crepitus readily felt. This fracture, which unites firmly and well by bone, must be treated in the same way as the last.

Compound Fractures of the Neck of the Thigh-bone can only occur from bullet wounds. In these cases the choice lies between amputation at the hip-joint, resection of the injured portion of bone, or treating the case as an ordinary compound fracture. The choice of the surgeon, for reasons stated at p. 133, lies between the latter two alternatives, which are the only ones that afford a reasonable hope of safety to the patient.

2. *Fractures of the Shaft of the Thigh-bone* are of very common occurrence; every possible variety of the injury being met with here. They are usually oblique, except in children, when they are commonly transverse, and are often comminuted, double, or compound.

The *Signs* are well marked. There is shortening usually to a considerable extent, with eversion of the limb, crepitus readily produced, and much swelling from the approximation of the attachments of the muscles. The lower fragment is always drawn to the inner side of the upper one, and rotated outwards; and when the fracture is high up there is a great tendency to angular deformity, in consequence of the projection outwards of the lower end of the upper fragment.

I have had an opportunity of ascertaining by dissection the condition of parts that leads to this eversion and projection forwards of the lower end of the upper fragment in fracture of the femur. It was in the case of an old man who died about three hours after meeting with a compound comminuted fracture of the middle and lower thirds of the right thigh-bone, and in whom this condition of the upper fragment was very distinctly marked. It was found that the gluteus maximus and medius could be divided without affecting the position of the bone; but when the gluteus minimus was cut across, it yielded somewhat. The pyriformis and external rotators were now felt to be excessively tense; and, on cutting these across, the end of the fragment could at once be drawn inwards, all opposition ceasing. The projection forwards still remained, however; and this, which was evidently due to the tension of the psoas and iliacus muscles, yielded at once on dividing them. It would thus appear that there is a double displacement of the lower end of the upper fragment; outwards, depending on the action of the external rotators; and forwards, owing to the contraction of the psoas and iliacus muscles.

The *Treatment* of fractures of the shaft of the thigh-bone may be conducted in four different ways, each of which presents advantages in particular forms of these injuries, hence an exclusive plan of treatment should not be adopted.

1. The fracture may be treated by simply relaxing the muscles of the limb. This is effected by laying it upon its outer side, flexing the thigh well upon the abdomen and the leg upon the thigh, and supporting the limb in this position by an angular wooden or leather splint extending from the hip to the knee or outer ankle, and by a short inside thigh-splint. This position I have occasionally adopted in fractures about a couple of inches below the trochanters, in which there is a great tendency to the projection outwards of the lower end of the upper fragment, and have found these cases turn out better in this way than by any other plan of treatment.

2. Extension, without regard to muscular relaxation, by means of Liston's long-splint and perineal band, will be found a most successful plan of treating fractures in the middle and lower parts of the thigh.

In employing the long splint for the treatment of these fractures, care must be taken that it be of sufficient length to extend about six inches below the sole and nearly as high as the axilla. The perineal band should consist of a soft handkerchief covered with oiled silk, and must be gradually tightened. If the perineal band occasion excoriation or undue pressure, so as to necessitate its removal, I have found advantage from keeping up extension with a heavy weight attached to the lower end of the splint.

In cases of compound fracture, where the aperture exists in the posterior and outer part of the limb, I have found a long thigh-splint, made of oak and bracketed opposite the seat of injury, the most convenient apparatus, enabling the limb to be kept of a proper length, and the wound to be dressed at the same time (Fig. 111).



Fig. 111.—Compound Fracture of Neck of Thigh Bone. Treatment.

3. The double inclined plane is especially useful in many compound fractures of the thigh, often admitting of greater facilities for dressing the wound, and the general management of the case, than any other apparatus that can be applied.

4. The starched bandage may be employed in most cases. In treating fractures of the shaft of the femur with the starched bandage, the following plan will be found convenient. A dry roller should be applied to the whole of the limb evenly and neatly, which must then be covered with a thick layer of wadding; a long piece of strong pasteboard, about four inches wide, soaked in starch, must next be applied to the posterior part of the limb, from the nates to the heel. If the patient be very muscular, and the thigh large, this must be strengthened, especially at its upper part, by having strips of bandage pasted upon it. Two narrower strips of pasteboard are now placed, one along each side of the limb, from the hip to the ankle, and another shorter piece on the fore part of the thigh. A double layer of starched bandage should now be applied over the whole, with a strong and well-starched spica. It should be cut up and trimmed on the second or third day, and then reapplied in the usual way. With such an apparatus as this I have treated many fractured thighs, both in adults and children, without confinement to bed for more than three or four days, and without the slightest shortening or deformity being left (Fig. 83). The points to be specially attended to are, that the back pasteboard splint be very strong, at the upper part especially, and that the spica be well and firmly applied, so that the hip and the whole of the pelvis be immovably fixed.

A simple comminuted fracture of the thigh-bone is usually best treated in the double inclined plane for the first three weeks, after which it may be put up in the starch bandage.

The Treatment of Compound and Comminuted Fracture of the Thigh-bone will vary according as the injury arises from gun-shot injury, or is an accident of civil life. In the former case, for reasons stated at p. 131, amputation should at once be performed if the fracture be below the upper third of the bone. When the upper third is splintered, the result of

amputation is so very unsatisfactory, that the patient may have a better prospect of recovery if the limb be treated in splints, and an endeavour made to save it, disarticulation at the hip-joint in such cases being almost invariably fatal.

When a compound, and even a comminuted fracture of the thigh-bone, occurs from one of the common accidents of civil life, the line of practice is not so defined. The course that the surgeon adopts must be influenced by the extent of injury done to the soft parts, more particularly to the main blood-vessels of the limb. If the integuments and muscles be extensively torn and lacerated, or if there be reason to believe that the femoral vessels have suffered, amputation must be practised. But if the wound be of but small size, made by the perforation of the bone rather than by the violence which occasioned the fracture, and if the vessels be uninjured, an attempt must be made to save the limb, which should be put up on the double inclined or in the long bracketed splint.

The treatment of the complication of a wound of the main artery, femoral or popliteal, with and by a fracture of the thigh-bone, will vary according as the injury is compound or simple. Such an accident, complicating a compound fracture, is necessarily a case for immediate amputation. If the fracture be simple, and a diffused traumatic aneurism form in the ham or lower part of the thigh, we must, in accordance with the principles laid down at p. 232, ligature the superficial femoral artery; unless gangrene be supervening, or have actually supervened, when amputation of the thigh must be practised above the line of fracture.

In discussing the treatment of these accidents, in which the question of amputation of the thigh is raised, I cannot too strongly state my convictions that, unavoidable as it undoubtedly is in some cases, as the only alternative left to the surgeon, this operation, when practised primarily for injuries of the thigh-bone itself, is one of the most fatal in surgery, and should accordingly not be too hastily resolved upon.

3. *Fracture in the Vicinity of the Knee-joint.*—The lower end of the thigh-bone is not unfrequently broken across in a transverse direction, both condyles being detached. This most readily occurs in children from the lower epiphyses not being as yet solidly united to the shaft of the bone. In other cases, the fracture extends through one of the condyles, detaching it from the shaft of the bone. The readiness with which crepitus can be felt, the line of fracture made out, and the displacement removed by lateral pressure, determines at once the nature of this accident. These cases are best treated on the double inclined plane. I have had several cases of impacted fracture in this situation under my care. In one, the upper fragment, which was very oblique, was firmly driven in the cancellous structure of the lower one (Fig. 112). In another case, the condyles of both thigh-bones were splintered into a number of fragments, amongst which the shafts were impacted. Excellent union, however, took place, the skin having been uninjured. Fracture of the lower end of the thigh-bone, communicating with open wound of the knee-joint, is necessarily a case for amputation.



Fig. 112.—Impacted Fracture of Lower End of Thigh Bone.

FRACTURES OF THE PATELLA may be the result of direct violence, when

the bone is often comminuted, or even broken longitudinally, being split, and the joint possibly injured. But most frequently they occur as the consequence of muscular action; the bone being torn across by the violent effort made by the extensor muscles of the thigh, in the attempt a person makes to save himself from falling when he suddenly slips backwards. All fractures of the patella from muscular action are transverse; the lower portion of the bone being fixed by the ligamentum patellæ, the upper segment is torn off by the spasmodic action of the extensors at the moment when the knee is bent, whilst the person is in the act of falling backwards. The patient does not break his patella in these cases by falling upon it, but he falls because the patella has been torn asunder by the violent and almost spasmodic action of the extensors of the thigh in his effort to save himself. In consequence of these fractures being occasioned by muscular action, they are more frequent in men, especially about the middle period of life, less common in women, and extremely rare in children. I have once, however, had under my care a child under ten years of age, who had a transverse fracture of the patella. It not unfrequently happens when one patella has been fractured, that the unsteadiness of gait causes the opposite one to be broken

by muscular action in an effort to save a fall. The same patella may be broken more than once; in the cases that I have seen, the second fracture has always occurred in the upper fragment, a little above the line of the original fracture.



Fig. 113.—Fracture of Patella. Separation between Fragments increased by bending the knee.

The Signs of this fracture are very evident. When it is transverse, the separation between the fragments, which is much increased by bending the knee (Fig. 113), and the inability to stand or to raise the injured limb, indicate what has happened; when it is longitudinal or comminuted, the crepitus and mobility of the fragments point it out; and there is usually considerable swelling of the knee-joint in these cases, with, perhaps, wound of it.

Mode of Union.—When the bone is broken transversely, it very rarely indeed unites by osseous matter, in consequence of the wide separation of the fragments; there are, however, two or three cases on record in which this kind of union has taken place in these fractures. In the longitudinal and comminuted fractures, osseous union readily occurs, the fragments remaining in close apposition. In the majority of cases of transverse fracture, the fragments remain separated by an interval varying from one-fourth of an inch to an inch; but in some instances the gap is much greater, amounting even to four or five inches. When the separation does not exceed an inch and a half, the gap is usually filled up by fibrous or ligamentous tissue, uniting the fragments firmly. In some of the cases, however, in which the separation between the fragments does not exceed this distance, and in most of those in which it extends beyond it, Mr. W. Adams has found that the fracture is not united by any plastic matter that has been thrown out, but that the fragments are bound together simply by the thickened fascia which passes over the patella, with which is incorporated the bursa patellæ. Mr. Adams finds that the aponeurotic structure thus uniting the fragments may be arranged in different ways. Thus it may pass between, and be adherent to the anterior periosteal surface of both fragments; or the connecting aponeurosis may be reflected over, and be adherent to, both the fractured surfaces; or, lastly,

(and this is the most frequent form of arrangement) the connecting aponeurosis may pass from the periosteal surface of the upper fragment to the fractured surface of the lower one, to which it becomes closely and firmly united. In the majority of cases, when united by aponeurotic tissue, the fragments gape somewhat towards the skin, coming into better contact posteriorly. Thus, it would appear that a patella fractured transversely may unite in two ways; most frequently by the intervention of thickened aponeurotic structure, and next, by a ligamentous or fibrous band. Of 31 specimens in the London museums, examined by Mr. Adams, it was found that in 15 aponeurotic union had taken place, in 12 ligamentous union, and in the remaining 4 the kind of union could not be determined.

The aponeurotic union always leaves a weakened limb and an unprotected joint, for, in consequence of the separation of the fragments, the folding in of the fascia, and its adhesion to the capsule of the joint, the fingers can be thrust in between the articular surfaces of the knee.

Treatment.—The principal point to be attended to is, to keep the fragments in sufficiently close apposition for ligamentous union to take place between them. With this view, the upper fragment, which is moveable, and has been retracted by the extensor muscles of the thigh, must be drawn down so as to be approximated to the lower one, which is fixed by the *ligamentum patellæ*. This approximation of the fragments may be effected either by position and relaxation of the muscles, or by mechanical contrivance. By placing the patient in a semi-recumbent position, and elevating the leg considerably, so as to relax the muscles of the thigh completely, the upper fragment may be brought down to the lower one, and, if necessary, may be retained there, after any local inflammation that results from the accident has been subdued, by moulding a gutta-percha cap accurately to and fixing it firmly upon the knee, or by the application of pads of lint and broad straps of plaster. This position must be maintained for at least six weeks; at the expiration of which time the patient may be allowed to walk about, wearing, however, an elastic knee-cap, or, what is better, a straight leather splint in the leg, so as to prevent the knee from being bent for at least three months. If this precaution be not taken, the union between the fragments, which at first appear to be in very close contact, will gradually lengthen, until in the course of a few months an interval of several inches may be found between them. In these cases, however, even though the separation between the fragments be great, it is remarkable how well the limb may be used, especially on level ground; and with the aid of a knee-cap but little inconvenience is experienced by the patient.

In most cases of fractured patella the starched bandage will be found a very useful mode of treatment, the patient being with it enabled to walk about during the whole of the treatment. The action of the bandage is much increased by drawing down and fixing the upper fragment by two broad strips of plaster firmly applied above it. A back splint of pasteboard is required to fix the knee, and a good pad of lint with a figure-of-8 bandage should be applied above and below the fracture to keep it in position. In several cases I have obtained very close and firm union between the fragments in this way, without confining the patient to bed after the third day, and now seldom employ any other method of treatment.

In *Simple Comminuted Fractures of the Patella*, the result of blows or lacerations, union takes place readily by bone.

Compound and Comminuted Fractures of the Patella, especially if occasioned by laceration, and opening the knee-joint, are usually cases for immediate amputation.

FRACTURES OF THE LEG.—The bones of the leg are frequently broken. The tibia, though a stronger bone than the fibula, is most frequently fractured, owing to its being more exposed and less protected by muscles, and receiving more directly all shocks communicated to the heel. The fractures of the upper part of this bone are usually transverse, and result from direct violence; those of the lower part are oblique, and proceed from indirect violence. When both bones are broken, the usual signs of fracture, such as shortening, increased mobility at the seat of injury, and crepitus, render the diagnosis easy; but when one bone alone is broken, it is not always a very simple matter to determine the existence of the fracture; the sound bone, acting as a splint, prevents displacement, and keeps the limb of a proper length and steady. If it be the tibia alone that has been broken, the fracture may be detected by running the finger along the subcutaneous edge, until it comes to a point that is somewhat irregular, puffy, or tender, where by accurate examination some mobility and slight crepitus may be detected. When the fibula alone is broken, the thick layer of the peroneal muscles, overlaying its upper two thirds, renders the detection of the fracture difficult; but in the lower third it is easy, by attention to the same signs that occur in fractured tibia.

In the *Treatment* of fractures of the leg, M'Intyre's splint will usually be found of great service during the earlier periods, more especially if there be much ecchymosis or extravasation, as it keeps the limb in an easy position, and admits of the ready application of evaporating lotions. After the swelling has subsided, the starched bandage should be applied, and the patient be allowed to move about on crutches. In some cases of fracture of the bones of the leg, however, M'Intyre's apparatus is not applicable. This is more particularly the case when the fracture is very oblique, from above downwards, and from before backwards; under these circumstances, the fragments cannot be got into good position so long as the limb is kept extended and resting on its posterior surface; the bones riding considerably, and one or other of the fractured ends pressing upon the skin in such a way as often to threaten ulceration. In those cases it is, that division of the tendo Achillis has been practised, with a view of removing the influence of muscular contraction. This appears to me, however, to be an unnecessarily severe procedure, and certainly was not a very successful one in two cases in which I practised it; for although the tendon was exceedingly tense, but temporary benefit resulted, the displacement returning under the influence of the other muscles inserted into the foot. In these cases the bones may usually be got into excellent position by flexing the thigh well upon the abdomen, and the leg upon the thigh, so that the heel nearly touches the nates, and then laying the limb on its outer sole on a wooden leg splint, provided with a proper foot-piece, and keeping it fixed in this position. In some cases the swing box will be found a useful and very easy apparatus. In some fractures of the leg, the lower end of the upper fragment projects considerably, and cannot be got into proper position so long as the knee is kept bent; but if it be extended, so as to relax the extensors of the thigh, the bone is readily brought into good position. In fractures of the leg, however, as in all injuries of a similar kind, no one plan of treatment should be adopted exclusively, but the means had recourse to should be varied and suited according to the peculiarities of each individual case.

For the treatment of *Complications of Simple Fracture of the Leg*, see pp. 232-235.

Compound Fractures of the Tibia are of more frequent occurrence than similar injuries of any other bone in the body. This is owing to the thin covering of soft parts over the anterior and inner aspect of the bone, and

to the fact of these fractures being usually oblique ; so that the sharply pointed end of the upper fragment is liable to be thrust through the integument, when the lower part of the limb falls backwards as the injured person is being raised off the ground. The fracture may, of course, also be rendered compound by the same direct violence that breaks the bone.

The *Treatment* and probable result of the case will in a great measure depend upon the way in which the fracture has been rendered compound, and on the amount of the laceration and contusion of the integuments. When the wound in the integuments is the result of their transfixion by the point of the upper fragment, it may commonly be closed by the first intention, by laying over it a piece of lint soaked in blood or in collodion, after reduction has been effected, and the limb put in a M^cIntyre's splint, the lint being left undisturbed as long as possible. Should there be difficulty in preventing the protrusion or in effecting the reduction of the pointed fragment, this must be cleanly sawn off, or the wound be enlarged so as to sink it, as directed at p. 238.

In the event of there being great contusion and laceration of the soft parts, as when the fracture is rendered compound by a waggon-wheel passing over the leg, it is useless to adopt the routine practice of attempting to close the wound by laying over it a piece of lint soaked in blood or collodion. It cannot unite, as in the other case, by the first intention. Suppuration must take place, and this is best met at once by the application of water-dressing after reduction. Indeed, in cases of this kind, the greatest danger results to the patient from the surgeon plastering the wound over with a piece of lint rendered hard and impervious by dried blood. The inflammatory discharges are prevented from escaping ; and unhealthy pus or broken-down blood accumulates in the limb, which becomes greatly swollen, tense, red, painful, and hot. The patient becomes restless ; high irritative fever is set up ; and, unless relief be given by the evacuation of the pent-up discharges, by opening up the wounds freely, and perhaps by free incisions and counter-openings as well, the worst forms of pyæmia will almost inevitably ensue.

If the tibia be much comminuted and the fracture compound, the case is usually one for amputation ; but should the patient be young and vigorous, an attempt even in such cases may be made to save the limb. Here a good deal may be done in the way of picking out detached splinters of bone, and sawing off smoothly the jagged and pointed ends of the adherent fragments. The length of the tibia will thus be lessened, and the patient will recover with a necessarily shortened, but otherwise firm and useful limb. Care must be taken in the after-treatment of such cases that too effective extension be not adopted, lest a gap be left between the fractured ends, which cannot be filled up with callus ; the consequence being that, in the attempt to obtain good length of limb, want or imperfection of consolidation results.

In both the last classes of cases, tension of the limb from deep abscess, usually requiring incision, may ensue ; or the consolidation of the fracture and the healing of the wound may be retarded by necrosis of some of the fragments, or if the extremity of one of the fragments, generally the lower end, is not unfrequently, after a proper but unsuccessful attempt to save it, the profuseness of the suppuration and the amount of constitutional debility may render imperative secondary amputation above, at, or below the knee, which in civil practice has been attended, in both the leg and the thigh, with more satisfactory results than have followed the primary operation. For the consideration of the question of Secondary Amputation,

see p. 41.

It is not an uncommon complication of compound fractures of the leg.

When venous and moderate in quantity, it may be arrested by position and cold. When arterial and abundant, proceeding from laceration of one of the tibials, it is useless for the surgeon to attempt to secure the bleeding vessel by groping amongst and under the deep muscles of the limb, infiltrated and disorganised as they are by the injury and by extravasation. It is equally futile, in these cases, to ligature the superficial femoral artery. Such an operation either fails in arresting the hemorrhage, or, if it stop the circulation sufficiently for this, gives rise to gangrene. There is, consequently, no resource but amputation; and the sooner this is practised, the better will be the patient's chance of recovery.

In fractures of the leg, the starched bandage is especially applicable. It should be applied as follows. The limb having been well covered with wadding, a strong soaked pasteboard splint, four inches broad, and long enough to extend from above the knee to six or eight inches beyond the heel, should be applied to the back of the leg. The projecting terminal piece is now to be turned up along the sole of the foot, and two lateral strips adapted, one to each side of the limb. Over these the starched bandage, single or double according to the size of the limb, must be tightly applied. After it is dry, about the end of the second day, it must be cut up as represented in Fig. 90, and re-adjusted, and the patient may then walk on crutches with perfect safety. In compound fractures of the leg, a trap may be cut in the bandage, as represented in Fig. 91, through which the wound can be dressed.

Fractures in the Vicinity of the Ankle-joint are amongst the most common injuries of the bones of the lower extremity. They are usually occasioned by twists of the foot, by catching it in a hole whilst running, by jumping from a height to the ground, or off a carriage in rapid motion. These fractures are usually associated with severe strain, or even dislocation, of the ankle. Twist of the foot in these cases must not be confounded with dislocation of the ankle. In a twist the foot carries with it the lower fragments of the leg-bones, and the malleolar arch in a more or less perfect state. In a dislocation, the foot is thrown out from under this arch. The twist of the foot is almost invariably outwards, with the inner side downwards and the outer edge turned up, or the sole remaining in this direction, though not always to the extent that Dupuytren states, and the inner malleolus projecting under the skin. Most commonly the toes are turned somewhat out, and the heel in.



Fig. 114.—Fracture of Tibia and Fibula above Ankle.

Fractures of the lower ends of the tibia and fibula present four distinct varieties in degree.

1. The fibula may be broken at from two to three inches above the malleolus externus, the deltoid ligament being either stretched or torn.
2. The fibula may be fractured about three inches above the ankle, the tip of the malleolus internus being splintered off as well. This constitutes the form of injury called *Pott's Fracture*, and is perhaps the most common fracture in this situation.
3. The fibula may be fractured at about three inches above the ankle, and the lower end of the tibia at the same time be splintered off in an oblique direction, from without, downwards and inwards (Fig. 114).
4. The internal malleolus may alone be broken off, the fibula remaining sound, but one of the divisions of the external lateral ligament being torn through.

The *Signs* of these fractures vary somewhat according to the bone that is injured. When the fibula alone is broken, there is but slight displacement of the foot, but great pain and much swelling, with perhaps indistinct crepitus, and irregularity of outline at the seat of fracture. If the tip of the inner malleolus be broken off as well, this may be ascertained by feeling the depression above the detached fragment. In those cases the crepitus is more distinct, and the displacement of the foot is much more marked, the sole being turned somewhat upwards and outwards, and the patient resting upon its inner side. It is this peculiar twist of the foot with its outer edge turned up, and the inner side down, that constitutes the characteristic sign of Pott's fracture. In those cases in which the lower end of the tibia is obliquely splintered, as well as the fibula broken, there are not only the ordinary signs of fracture, with eversion of the toes, and a corresponding turning inwards of the heel, and some rotation of the foot outwards, but the malleoli are widely separated, giving an appearance of great increase of breadth to the joint: crepitus is very readily felt, and a depression can be perceived corresponding to the line of fracture.

The *Treatment* of these cases is always fraught with difficulty. In consequence of the swelling and inflammation that usually occur, it is often difficult to exercise that amount of traction and pressure necessary for the proper co-adaptation of the fragments. This difficulty is greatly increased by the small size and short leverage afforded by the fragments; and so great is it, that in some cases it cannot be overcome, but a certain degree of displacement results as the necessary consequence of the injury, leaving a weak and painful joint, the mobility of which is seriously impaired.

If, as usually happens, more particularly when the fracture results from direct violence, there be a good deal of swelling from ecchymosis and inflammatory action, this will require to be subdued by the continuous application of cold before any apparatus can be applied. If there be not much displacement of the foot, the treatment may best be conducted by splints with good foot-pieces, and the starched bandage. If the foot be much twisted outwards, as in

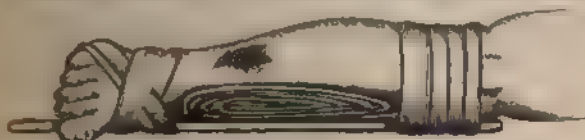


Fig. 115.—Pott's Fracture: Application of Dupuytren's Splint

Pott's fracture, Dupuytren's splint should be applied to the inner side of the limb, so as to counteract the displacement. The pad should be folded double at the lower end, and not descend below the ankle, so as to form a fulcrum, across which the foot may be drawn to the inner side (Fig. 115). Much stiffness is always left after union has taken place, the ankle remaining rigid, weak, and useless for a long time.

Compound Fracture into the Ankle-joint, though necessarily a serious and dangerous accident, may often be recovered from with a good and useful limb, more particularly when occurring to young subjects of sound constitution. In such individuals, even though the injury be very extensive and severe, recovery may take place; but as age advances, and the constitution becomes more broken, less is to be expected from conservative surgery.

In the *Treatment*, the course to be pursued will depend upon the extent of the injury. If the fracture be not much comminuted, the wound in the soft parts clean cut and but moderate in extent, and the large vessels of the foot uninjured, an attempt should be made to save the limb. If, on the

other hand, there be great comminution of bone, with dislocation of the foot, and, perhaps, rupture of the posterior tibial artery, in a person at or above the middle period of life, amputation should be practised. But in a younger subject, such a serious injury even as this may be recovered from, if the surgeon remove loose fragments, saw off the splintered ends of the bone, and bring the soft parts together.

If an attempt be made to save the limb, whether any bone have been excised or not, it should be placed securely in a McIntyre's splint and kept immovably fixed; perfect fixity of the limb is here of the first consequence. If much of the fibula should require removal, Stromeyer has recommended that the limb be amputated instead, lest an useless foot, affected with a kind of valgus, be left. But, in children and young subjects, this inconvenience and deformity may be overcome by mechanical means; and the probability of its occurrence would not, in my opinion, justify amputation.

FRACTURES OF THE BONES OF THE FOOT almost invariably result from direct violence, and are usually accompanied by much bruising and injury of the soft parts; hence there is usually but little displacement, and, when the fracture is simple, rest and position alone are necessary. Compound fractures of the tarsal or metatarsal bones, attended by much bruising and laceration of the soft tissues, usually require partial removal of the foot, its disarticulation at the ankle-joint, or amputation in the lower third of the leg, according to the extent and severity of the injury.

The only special fractures of the foot requiring particular attention, are those of the *calcaneum*.

The *Calcaneum* may be broken by direct violence, as when a person jumping from a height alights forcibly on his heel, and thus fractures the bone. In this way, I have seen both *calcanea* extensively comminuted, being shattered to pieces, in the case of a lady, who, falling from a window on the third story, alighted on her heels. More commonly, however, the bone is simply broken across. In some rare cases, by the powerful contraction of the strong muscles of the calf, the posterior part of the *os calcis* is torn away from the rest of the bone.

Signs.—When the *os calcis* is simply broken through at its posterior part, beyond the insertion of the lateral ligaments, the detached fragment will be drawn up by the action of the strong muscles of the calf. But when the fracture occurs across the body of the bone, no displacement can take place, owing to the lateral and interosseous ligaments keeping the posterior fragment in position, and preventing its being drawn away.

In the first form of fracture, the pain, swelling, flattening of the heel, and prominence of the malleoli, indicate the nature of the injury, even though crepitus be wanting. In the second variety, the mobility of the fragment, and its projection posteriorly by the action of the muscles of the calf, point to the existence of the fracture, which is confirmed by the occurrence of crepitus.

In the *Treatment* of these injuries, subduing inflammatory action, keeping the part fixed, by means of bandage and gutta-percha splints, with due attention to the relaxation of the muscles, is all that can be done. Union probably occurs by bone in some cases, though very commonly by fibrous tissue.

CHAPTER XX.

DISLOCATIONS.

By a *dislocation* is meant the more or less complete displacement of the bony structures of a joint. In the orbicular joints, as the hip and shoulder, the osseous structures may be completely separated from one another, the dislocation then being *Complete*. In the hinge-joints, as the elbow and knee, the osseous surfaces commonly remain partially in contact, though displaced from their normal relations to one another: here the dislocation is *Incomplete*. In most dislocations the integuments covering the displaced bones are put greatly on the stretch; but in some they are ruptured, and then the dislocation is *Compound*. Besides these varieties, surgeons recognise *Spontaneous* dislocation, in which the displacement does not occur from external violence. In other cases again, the dislocation arises from *Congenital* malformation of the joint, in consequence of which the bones cannot remain in proper apposition.

CAUSES.—Dislocation is *predisposed* to by various conditions, amongst which the arrangement of the joint appears to exercise most influence; orbicular joints being more liable to dislocation than any of the other articulations, whilst in some of the synchondroses it never occurs. Malgaigne finds that of 491 cases of dislocation, 321 occurred in the shoulder, 34 in the hip, 33 in the clavicle, 26 in the elbow, 20 in the foot, besides others in the thumb, wrist and jaw.

Dislocations are seldom met with in children, in whom fractures of the epiphyses more readily occur. I have, however, had under my care a child just one year old, with dislocation of the head of the femur on the os pubis, occasioned by another older child dragging it along the ground by its leg; and Travers has seen the hip dislocated in a boy five years of age. In old people the bones are so brittle, and the ligaments so tough, that violence causes fracture rather than dislocation. Hence it is principally in young and middle-aged subjects that dislocations are met with. This is well illustrated by an analysis of 84 cases of dislocation of the hip-joint, collected by Hamilton of these, 15 occurred under 15 years of age, 32 between 15 and 30, 29 between 30 and 45, and 8 between 45 and 85. They are necessarily far more common in men than in women, from the nature of their respective occupations. Thus, according to Hamilton, of 115 dislocations of the hip, only 11 occurred in women.

It is well known that it is rather owing to the continuous tension of the muscles, than to any arrangement of osseous and ligamentous structures, that the articular ends of the bones of the extremities are kept in their proper positions, and that considerable external violence may be applied to a limb without dislocating it. If, however, the muscles be taken by surprise, or if they have been weakened by previous injury of any kind, the joint becomes predisposed to dislocation, and may be displaced under the influence of very slight causes. In this way the same joint may be repeatedly dislocated. Thus I have seen a man whose humerus had been dislocated between forty and fifty times, owing to a weakened state of the deltoid.

The *Direct Causes* of dislocation are *external violence* and *muscular action*. *External violence* may act directly upon a joint, forcing or twisting the articular ends asunder, as happens when the foot is displaced by a twist

of the ankle, or when the thumb is dislocated backwards by a blow. But more commonly the force acts at a distance from the joint that is displaced, and the head of the bone is thrown out of its socket by "the lever-like movement of the shaft," as happens when the head of the humerus is dislocated by a fall on the hand.

Muscular action alone may cause the dislocation of a bone, even though the part be previously in a sound state. Thus, the lower jaw has been dislocated by excessive gaping, and the humerus by making a violent muscular effort. If the joint have already been weakened by previous injury or disease, muscular action is especially apt to occasion its displacement. The congenital dislocations, in all probability, arise from irregular muscular contractions in the foetus, by which the bones are displaced, and the normal development of the joint is interfered with. In dislocations of the orbicular joints, after the head of the bone has been thrown out of its articular cavity, it is often still further displaced by the contraction of the muscles, which continues until they have shortened themselves to their full extent, or until the dislocated bone comes into contact with some osseous prominence that prevents its further retraction.

SIGNS.—The existence of a dislocation is rendered evident by the change in the shape of the joint, and in the altered relation of the osseous prominences to one another; by the articular end of the displaced bone being felt in a new position; and by an alteration in the length of the limb, and in the direction of its axis. Besides this, there are after a time, if not immediately on the occurrence of the accident, impaired motion of the injured articulation, and pain in and around it.

EFFECTS.—The effects of dislocation on the structure of a joint are always of a serious character. The bones that enter into the formation of the articulation are not unfrequently fractured as well as displaced, more particularly in huge-joints; the cartilages may be injured, and the ligaments are always much stretched and more or less torn, the capsule of the joint suffering especially. In many cases, the muscles and tendons in the immediate neighbourhood are lacerated as well as displaced, and the vessels and nerves compressed. The skin is commonly stretched, and sometimes ruptured, when the dislocation becomes *compound*. If the dislocation be a simple one, and if reduction be speedily effected, these injuries are soon repaired; and although a good deal of stiffness may continue about the joint, its functions are, in general, not permanently interfered with.

If the dislocation be left unreduced, important changes take place within and around the joint, in the bony structures, the ligaments, capsule, and muscles. The changes in the bony structures are very slow, differing in this respect materially in ordinary traumatic dislocations, from what takes place in a joint that has been dislocated as the result of disease. If the articulation be an orbicular one, as the shoulder or hip, the cavity, whether glenoid or acetabular, undergoes very gradual changes in outline and depth; its circumference becomes contracted, less regular, more angular, and it eventually shallows. These changes are so slow in the adult, that several years will elapse before they have gone on to such a degree as to prevent the displaced head of the bone from being put back. In children and young people they are more rapid and complete, and the cavity fills up with a dense fibrous deposit. In the hinge-joints, the articular ends of the displaced bones become altered in shape—flattened or angular, with the osseous projections less strongly marked. The incrusting cartilage is gradually absorbed, and the bone smoothed. The ligaments are shortened and wasted; and a false joint forms around the articular end of the bone in

its new situation. In some cases, the bone upon which the dislocated head rests becomes depressed into a shallow cup shaped cavity, so as to receive it; in others, the depression is formed by the elevation of a rim of callus upon the adjacent bone; and in both instances the cellular tissue in the neighbourhood becomes consolidated into a capsule of a fibrous character, surrounding and fixing the bone in its new situation, and usually admitting of but a limited degree of motion. The soft structures that have been lacerated at the time of the dislocation become matted together by plastic material; the muscles shorten, atrophy, and at last undergo fatty degeneration from disuse; the neighbouring vessels and nerves may become attached to the new joint, or their sheaths become incorporated with the altered structures in contact with them.

TREATMENT.—In the treatment of dislocations, the first and principal indication consists in replacing the bone in its normal situation as speedily as possible. In doing this, the surgeon has two great difficulties to overcome—1, the contraction of the muscles of the part; and, 2, the anatomical structure of the joint.

1. The great obstacle to reduction is, the tonic contraction of the muscles inserted into or below the displaced bones; and in the reduction of the dislocation the surgeon's efforts are chiefly directed to overcome this contraction. The longer the dislocation is left unreduced, the more powerful does this become; being less at the moment of the accident, and immediately afterwards, than at any subsequent period. Hence reduction should be attempted as soon as possible after the occurrence of the accident, and, if the patient be seen at once, the bone may sometimes be replaced without much difficulty by the unaided efforts of the surgeon. Thus Liston reduced a dislocated hip by his own endeavours immediately after the accident occurred. If a few hours have elapsed, the muscular tonicity becomes so great that special means must be adopted in order to diminish it; and if some weeks or months have been allowed to pass by, the dislocation may have become irreducible, partly owing to permanent contraction of the muscles which have been shortened by the approximation of their attachments, and which it is impossible to overcome, but chiefly to the cohesion of the surrounding tissues, and the formation of adhesions about the head of the bone.

In the reduction of a recent dislocation, advantage may sometimes be taken of the occurrence of faintness, or of the patient's attention being distracted to other matters, in order to effect the return, the muscles being then taken by surprise, and the bone readily slipping into its place. Such aids as these, however, cannot be depended upon; and muscular relaxation should be induced by the administration of chloroform or ether. By the employment of these valuable agents, the muscles of the strongest man may be rendered so perfectly flaccid and powerless in a few minutes as to oppose no action whatever to reduction, which has thus been wonderfully simplified and facilitated. In no department, indeed, of practical surgery has the administration of anæsthetic agents been attended by more advantageous results than in this.

Mechanical Contrivances are much less frequently had recourse to for the reduction of dislocation now than formerly. It is, however, occasionally necessary to employ apparatus calculated to fix the articular surface from which the bone has escaped, and to draw down the displaced bone to such an extent that it may be replaced on the surface on which it should be lodged. If the patient have not been anæsthetised, it will be found that, when the bone is well brought down by the extending force so as to be opposite

its articulation, being disentangled from osseous points upon which it may have hitched, it will be drawn at once into its proper position by the action of its own muscles, with a sudden and distinct snap; the muscles of the part being the most efficient agents in the reduction, so soon as the bone is placed in a position for them to act upon it. When, however, the patient has been placed under the influence of chloroform, the muscular system being thoroughly relaxed, the bone will not slip into its place with a snap or sudden jerk, but is reduced more quietly, and rather by the efforts of the surgeon than by any sudden contraction of its own muscles. It is important to note these differences in the mode of reduction; lest the surgeon, when chloroform has been fully administered, failing to hear the snap or feel the jerk which he expected, should imagine the bone not to be reduced, and continue an improper degree of extension.

The purely mechanical means for the reduction of dislocation are sufficiently simple: the patient's body, and the articular cavity into which the luxated bone is to be replaced, are fixed by a split sheet, a jack-towel, a padded belt, or some such contrivance, by which *counter-extension* is practised. In some cases the hands of an assistant, or of the surgeon himself, or the pressure of his knee or heel, constitute the best counter-extending

Extension may be made either by the surgeon grasping the limb to be reduced and drawing it downwards, or else by means of a bandage or jack-

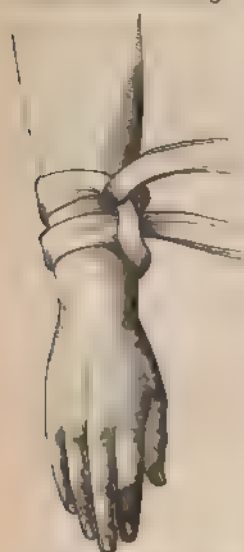


Fig. 116—Bandage applied for extension. Clove hitch knot.

towel fixed upon the part, with the clove-hitch knot applied in the way represented in the annexed cut (Fig. 116). If more force be required, the multiplying pulleys (Fig. 139), or the dislocation-tourniquet invented by Mr. Bloxam (Fig. 138), may be used, by which any amount of extending force that may be required can readily be set up and maintained. The "adjuster" invented by Dr. Jarvis is a useful and powerful instrument for the same purpose. These contrivances, however, are much less frequently required now than formerly, owing to surgeons taking advantage of the paralyzing effects of chloroform upon the muscular system, and consequently not requiring so much force to overcome its contraction. When any powerful extending force is applied, the skin of the part should always be protected from being chafed by a few turns of a wet roller. The extension must be made slowly and gradually without any jerking, equality of motion as well as of force being attended to. In this way the contraction of

the muscles is gradually overcome, whereas sudden and forcible extension might excite them to reaction. The traction is most advantageously made in the axis which the limb has acquired in its new position, without reference to its normal direction or to the situation of the joint. In this way the head of the bone is made to pass along the same track which it has torn for itself in being dislocated, and thus is replaced without the infliction of any additional violence on the tissues around the joint.

The question whether the extending force should be applied to the bone that is actually displaced, or to the further end of the limb, has been much

discussed, and appears to have received more attention than it deserves. It is true that, by applying the extending force to the displaced bone itself, the surgeon has greater command over its movements, with less chance of injury to the intervening bones; whilst, by applying the extending force to the lower part of the extremity, he has the advantage of a longer lever for the reduction of the head of the bone. This lever, however, it must be remembered, is in many cases a broken one; and it cannot be made to act if the bone have to be replaced in the direction of the flexion of the joints that exist in its course. For this reason, we find that some dislocations are best reduced by applying traction to the bone itself that is displaced, as in luxations of the femur and of the bones of the forearm; whilst, in other cases, as in the dislocations of the humerus, most advantage is gained by applying the extending force to the end of the limb. But I look upon these points as of comparatively little consequence; believing that, when the patient is not anaesthetised, the muscles of the limb themselves effect the reduction without the necessity of the surgeon employing any very powerful lever-like action of the bone; and that, when the patient is paralysed by chloroform, the bone is in most cases readily replaced by the simple movements impressed directly upon it, or even upon its articular end, by the hands of the surgeon.

2. In reducing a dislocation, it is of especial importance to attend to the relation of the osseous points in the neighbourhood of the joint, and to disengage the displaced bone from any of these upon which it may be lodged. This is especially the case in such hinge-joints as the jaw and elbow, in which the arrangement of the articulation is somewhat complicated.

After the dislocation has been reduced, the bone must be retained in position by proper splints and bandages; the joint being kept quiet for two or three weeks, according to its size, so as to allow of proper union taking place in the capsule and neighbouring structures. Any consecutive inflammation may often be prevented by the continuous application of cold; and, if set up, must be treated by local antiphlogistic means.

The force required in effecting the reduction of recent dislocations is often very considerable. So great is the resistance offered by the muscles, that in some cases the dislocated bone has given way under the traction. I am acquainted with cases in which the humerus and the neck of the femur have both been broken in effecting the reduction of recent dislocations. This accident does not appear to have been the result of any improper or unskilful employment of force, but to have occurred from natural weakness of bone. We know that "spontaneous" fractures frequently take place from muscular action, often of a very slight kind; and we can easily understand that if a bone that would be liable to such ready fracture happened to be dislocated, it would almost of necessity give way under the influence of the extending or lever like force required to replace it.

DISLOCATIONS OF OLD STANDING.—If a dislocation have been left unreduced for some weeks or months, changes, which have already been described, take place in and around the displaced articular structures, the terrible effect of which is to render the replacement of the bones in their normal position more and more difficult as time goes on, and to lead to the formation of a new though imperfect articulation at the seat of displacement.

When a dislocation has been left permanently unreduced for a considerable length of time, as for years, the amount of utility in the limb will depend partly on the kind of joint that has been dislocated, partly on the particular variety of dislocation that has occurred. Thus, as a general rule, greater freedom of movement and greater utility of limb will be found in old-

standing dislocations of ball-and-socket than of hinge-joints. But in ball-and-socket joints some dislocations will, if left unreduced, be attended with less evil consequences to the patient than others. Thus, in the *subglenoid* dislocation of the shoulder and the *sciatric* of the hip, the limb will recover itself to a greater extent than in the other forms of the same kind of injury affecting these joints.

Treatment.—In cases of very old and irremediable unreduced dislocation, much may be done by means of regularly conducted passive movements to increase the mobility of the part, and by means of friction and warm douches to relieve the tension and painful stiffness. In cases not so old, but in which some time has elapsed since the occurrence of the dislocation, two questions always present themselves to the surgeon:—1. Is it possible to replace the dislocated bone? 2. Is it desirable or prudent to attempt reduction?

The possibility of reducing the dislocation will depend partly upon the joint that is dislocated and the nature and extent of the dislocation, but chiefly on the length of time during which the bone has been out of place. Dislocations of the orbicular joints generally can be reduced at a much later period than those of the ginglymoid; those of the shoulder can be reduced after a longer lapse of time than those of the hip. The subglenoid dislocation of the shoulder and that of the hip on the *dorsum ili* are susceptible of reduction at a later period than the other luxations of the same joints.

The *latest period* at which reduction is possible has been variously estimated by different surgeons. Sir A. Cooper gives three months for the shoulder and eight weeks for the hip. As a general statement, this was no doubt a tolerably correct one at the time that it was made, although reduction had been effected at later periods than those given by Cooper. Thus Breschet reduced a dislocation of the hip at the 78th day, and Travers at the fifth month. But we may now go far beyond this as the limit of *possible* reduction. Thus, Brodhurst has reduced the shoulder on the 175th day; Smith (U.S.) in one case at the seventh month, in another at ten months and a half; Blackman of Cincinnati, a dislocation of the femur on the *dorsum ili* at six months; and Dr. Dupierriis of the Havana, one at over six months, in a boy, and this without chloroform.

The *obstacles to the reduction* of old-standing dislocations are rather pathological, than physiological and anatomical as in the case of recent displacements. They are of several distinct kinds:—1. The powerful tonic contraction of the shortened and displaced capsular muscles. 2. The organic changes that have taken place in these muscles, arising partly from their cicatrization after laceration, partly from a kind of rigid atrophy, the consequence of inflammatory action and of disease. 3. Adhesions that form between the lacerated capsule and muscles and the displaced head of the bone. 4. Lastly, as a more remote consequence than these, anatomical changes taking place in the articulating surfaces themselves, by which their shape becomes altered and the socket shallowed, contracted, and perhaps ultimately obliterated by fibroid deposits.

In order to overcome these obstacles a considerable amount of force must be used, as adhesions and contractions have to be stretched and torn asunder. This is effected by the multiplying pulleys and by manipulation under chloroform. In employing the necessary force, care must be taken to protect the skin from abrasion, or even laceration, by the use of wet flannel bandages or wash leather. The reducing force exercised by the pulleys must be *considerable*; but it should be accompanied with free rotatory manipulations and *movements of the head of the bone*, so as to loosen it from its adhesions.

and it will usually be found to be replaced in this way rather than by forcible traction only.

Chloroform is of inestimable service in these cases; and it is by the anæsthesia produced by it that the surgeon has been enabled to prolong materially the limit of possible reduction. But, in the reduction of old dislocations, chloroform does not afford exactly the same kind of service as in those of recent date. In a recent dislocation the chief obstacle is muscular contraction, and by relaxing this, chloroform enables the surgeon to replace the bone at once without difficulty. In old dislocations the obstacles, as has just been stated, consist in various pathological changes that have taken place around and in the displaced bones. These conditions cannot be influenced by anæsthesia; and hence, except as a means of producing insensibility to pain and preventing instinctive or voluntary muscular resistance on the part of the patient, chloroform will not aid the surgeon.

It must be borne in mind that the reduction of old dislocations is not only a work of very considerable difficulty, but also of no little danger. If several months have elapsed, the obstacles arising from the pathological changes already mentioned will usually be of so obstinate a character, as to render the reduction impossible without the employment of a dangerous amount of force, and in many cases they will be of a nature to prevent the possibility of the accomplishment of reduction, whatever force be employed.

The accidents liable to occur during attempts to reduce old dislocations, whether successful or not, are the following:—1. Laceration of the skin by the constriction and pressure of the bands to which the pulleys are attached. 2 Laceration of muscles: thus the pectoral has been torn through in attempted reduction of old dislocation of the shoulder. 3 The development of inflammation and suppuration around the dislocation, by the violence to which the soft parts have been subjected. From this cause death has several times resulted, in attempts at reducing old hip dislocations. 4. Extensive extravasation of blood from the rupture of small vessels in the lacerated soft parts, giving rise to wide-spread ecchymosis. 5. Laceration of one of the larger veins. A patient of *Froniep's* died from this cause, after rupture of the axillary vein, in an attempt to reduce an old dislocation of the shoulder. 6. Laceration of an artery, and the formation of a diffused traumatic aneurism. This serious accident has happened at least twelve times in attempted reduction of old dislocations of the shoulder. The brachial artery has also been torn in attempted reduction of the elbow. 7. Laceration of neighbouring nerves. Those of the axillary plexus have been torn in attempted reduction of dislocation of the shoulder, and the median in that of the elbow. 8. Fracture of the dislocated bone. This serious accident has usually happened when the surgeon, after the employment of extension, has attempted to put in force transverse movements of the bone, or has used it as a lever, when it has given way, usually high up near the head, at other times in the shaft. It is possible that in some cases it may have been predisposed to by the bone having become weakened by want of use. It has occurred several times in the humerus, and at least eight times in the femur, in attempts at reducing old dislocations of these bones. In most of the recorded cases the bone has readily united, and the condition of the patient has not been materially, if at all, influenced for the worse, except that reduction of the dislocation has necessarily been rendered impossible. 9 Neighbouring bones have been fractured, such as the ribs and the glenoid cavity in the endeavour to reduce dislocation of the shoulder, and the acetabulum in attempted reduction of a luxated hip.

The occurrence of these various accidents and injuries, in the attempted

reduction of old dislocations, cannot always with justice be attributed to the employment of an improper degree of force on the part of the surgeon. The liability to them must rather be looked upon as a necessary and inevitable accompaniment of all attempts at putting back into its place a bone which has been dislocated, and left unreduced for many weeks or several months. During this period it usually contracts adhesions of a very dense kind to the parts amongst which it lies; and, as it cannot be replaced in its articular cavity until these adhesions have been torn or broken through, it is easy to understand how, in the attempt to do this, neighbouring soft parts, vessels, or nerves may give way, or the bone itself may yield to the force that must be applied to it in order to lift it out of its new bed.

The liability to the occurrence of these accidents should make the surgeon very cautious how he recommends the attempt at the reduction of old-standing dislocations. If after a time the new joint have become tolerably mobile, and be not painful, it may be better to leave the bone unreduced, rather than expose the patient to great risk, with a slender prospect of eventual success. If the unreduced dislocation be stiff and painful, much may be done by passive motion, frictions, and douches, to improve the patient's condition.

The *subcutaneous* section of muscles, tendons, and bands of adhesions in the neighbourhood of the dislocated joint, has been proposed by Dieffenbach as a means of facilitating reduction in old-standing cases; and he relates an instance in which, by these means, a shoulder that had been dislocated for two years was reduced. In many cases in which this plan has been tried, the success has not been commensurate with the expectations raised respecting it; and in other instances, of which I have seen two or three, the operation has been followed by sloughing and other serious evils, while it has not been attended by any benefit in facilitating reduction.

COMPOUND DISLOCATION is one of the most serious injuries to which the limbs can be subjected. Not only is there such extensive laceration of the soft parts that cover and enter into the formation of the joint as to give rise to the most severe forms of traumatic arthritis, but the bones are often fractured, and the main vessels of the limb perhaps greatly stretched or torn.

The *Treatment* of a compound dislocation must be conducted on the same principles that guide the surgeon in the management of a wounded joint; obtaining union, if possible, by the first intention, subduing inflammatory action, and letting out matter as it forms. Owing to the rupture of the ligaments and of the muscular attachments, there is usually no difficulty in the reduction, the bones being readily replaced; but the danger consists in the destructive inflammatory action that will be set up in the joint and limb from the extensive injury inflicted upon them. This varies greatly, according to the size and situation of the joint, and the state of the soft parts. If it be small, as one of the phalangeal articulations, the dislocation may be reduced, and the parts covered with cold lint. If it be one of the larger joints, the line of practice will vary according to other circumstances than the mere dislocation. Thus, if it be in the upper extremity, the patient being healthy, and the soft parts not very extensively contused or torn, the bones may be replaced, cold irrigation assiduously applied, and antiphlogistic treatment pursued. If there be fracture conjoined with the dislocation, resection should be practised, as was successfully done by Hey in several cases of injury of the elbow of this description; but if the soft parts be greatly injured as well, and especially if the blood-vessels and nerves of the limb have suffered, amputation must be performed. In the lower extremity,

amputation is more frequently necessary; in the knee, almost invariably so. Sir A. Cooper states that he knows no accident that more imperatively demands amputation than compound dislocation of this joint. Yet there are exceptions to this rule; thus, Mr. White had a case of compound dislocation of the knee-joint in a boy, nine years of age, at the Westminster Hospital, in which he saved the limb by sawing off the condyles of the femur and relocating the bone. In the compound dislocations of the ankle and the astragalus, an attempt should generally be made to save the limb, in the way that will be more specially pointed out when we come to treat of these injuries.

After recovery from compound dislocations, the joint will often remain permanently stiffened; hence attention to position during the treatment is essentially required. In many cases, however, very good motion is ultimately obtained, though the stiffness may continue for some length of time.

COMPLICATIONS. — *Fracture of the shaft of one of the long bones with dislocation of its head* increases considerably the difficulty of reduction. Under these circumstances, it has been recommended to consolidate the fracture first, and then to attempt the reduction. But to do this is only to defer and increase the difficulties. At least seven or eight weeks must elapse before the fracture can be sufficiently firmly united to bear the requisite traction to reduce so old a dislocation; and then there will be great chance of rupture of the callus, and certainly extreme difficulty in the reduction. It therefore appears to me much safer, under all circumstances, to reduce the dislocation at once, and afterwards to treat the fracture in the ordinary way. In reducing a dislocation complicated with fracture of the shaft of the displaced bone, the fracture must first be put up very firmly indeed, with wooden splints completely encasing the limb. The patient must then be put fully under the influence of chloroform, which is of the most essential service in these cases; and, when the muscles are completely relaxed, extension and counterextension being made in the usual way, the reduction may be effected. The extending means should always be applied upon the splints, so that there may be no dragging upon the fracture. In this way I have reduced, without any difficulty, a dislocation of the head of the humerus into the axilla, complicated with comminuted fracture of the shaft of the bone, in a remarkably muscular man to whom I was called by Mr. Byam; and about the same time I had a case of dislocated elbow, with fracture of the shaft of the humerus, under my care at the hospital, that was reduced with ease in the same way. The difficulty in reduction is necessarily increased by the proximity of the fracture to the dislocated joint; and when the epiphysis is broken off from the shaft and dislocated, the difficulty may be great, but is not insuperable. A short time since, I assisted Mr. H. Smith and Mr. Dunn in the reduction of a dislocation of the humerus with fracture of the surgical neck of the bone, the displaced head lying to the inner side of the coracoid process. In this case the patient, a young man who had sustained the injury by a fall in an epileptic fit, was put under chloroform, and when he was fully anaesthetised the displaced head of the bone was replaced at once and without any difficulty; the patient recovering with an excellent and useful arm. After the bone has been reduced, the fracture should be treated in the ordinary way.

When a simple fracture extends into the articular end of the bone, as in some dislocations about the elbow and ankle, there is no material increase in the danger of the case or in the difficulty of its management.

In compound dislocation with fracture of the articular ends, removal of

splinters, and partial resection or amputation, will be required, according to the seat and extent of injury.

SPONTANEOUS DISLOCATIONS may occur either suddenly or gradually, according to the nature of the cause that gives rise to them.

In many cases they result from the *destruction of the joint by old disease*; the ligaments and cartilages being destroyed by suppuration, the head of the bone becomes carious and absorbed, and the articular surfaces are displaced by ordinary muscular action. This we commonly see in old cases of hip-disease.

There is, however, another and more rare form of spontaneous dislocation to which the hip and shoulder are liable, and which has been especially studied by Mr. Stanley. In this dislocation, the head of the bone slips out of the articulation without any very marked sign of disease about the joint, and certainly without any previous destruction of it. In these cases there is either a *paralytic condition of the capsular muscles*, as has been observed several times in the shoulder, the deltoid having become paralysed and thus having allowed the bone to slip out of place; or, as has been noticed in the hip, *obscure rheumatic or neuralgic pains* have for some time been seated in the joint. The dislocation may not be confined to one joint, but may affect several. Thus, some time ago there was a case in University College Hospital, in which both shoulders and hips were dislocated spontaneously. In many cases it occurs suddenly, and often without any pain to the patient, the deformity of the limb attracting attention to the accident, though in others it has been preceded by rheumatic affection of the joint.

The *Treatment* of these cases is not very satisfactory. Reduction in many cannot be accomplished; while in others it may be effected readily enough, but the bone cannot be fixed in the joint, out of which it slips again. In a case of spontaneous dislocation of the hip, without any apparent disease of the joint, occurring in a young woman, I readily effected reduction by the pulleys, three weeks after the occurrence of the displacement. The limb was then fixed with the long splint, and maintained at a proper length for two or three weeks; when, in consequence of a severe bronchitic attack, it became necessary to remove the apparatus, and the displacement speedily returned. Whilst convalescent from this attack, the patient fell and fractured the displaced femur in its upper third, thus rendering it impossible to replace the bone again. In another case of spontaneous dislocation of the knee, occurring in the same painless manner, the joint could not be replaced, and permanent deformity was left. After reduction in similar cases, a splint or a starched bandage should be worn for a considerable length of time, so as to give a chance for the ligaments of the joint to recover themselves. If there be a rheumatic tendency, it should be removed by suitable treatment; and if there be a paralytic condition of the muscles, electricity, the endermic application of strychnine, and cold douches with friction, may be advantageously employed.

CONGENITAL DISLOCATIONS are occasionally met with in the hip, shoulder, wrist, and jaw, and have of late years attracted the attention of surgeons through the labours of Guérin, Smith, Chelius, Robert, and others. These dislocations are closely allied in cause and nature with other congenital deformities of the limbs, such as club-foot, &c. In them there is usually found arrested or imperfect development of some portions of the osseous articular apparatus. Whether this is original, thus causing the displacement of the bones, or consecutive upon disease, occasioned by spasmodic action of one set of muscles or by paralysis of another, dependent on some irritation

to the nervous centres, is scarcely worth inquiring here. In some cases it would appear as if faulty position of the foetus in utero, or undue violence during birth, may have occasioned the displacement. These dislocations are probably incurable, as there is always congenital defect of structure in the articular ends of the bones.

CHAPTER XXI.

SPECIAL DISLOCATIONS.

DISLOCATIONS OF THE LOWER JAW are not common accidents. They occur more frequently in women than in men, and have been but very seldom met with at either extreme of life; but Nélaton and Malgaigne relate cases occurring in edentulous subjects of 68 and 72 years of age, and Sir A. Cooper has seen the accident in a child, occasioned by another boy thrusting an apple into its mouth. These dislocations are most frequently occasioned by spasmodic action of the depressor muscles of the jaw—by opening the mouth too widely, as in fits of laughing, of gaping, or in attempting to take too large a bite. Occasionally this accident has resulted from blows or kicks upon the chin, or from the violent strain upon the part in tooth-drawing, or rather in digging out stumps with an elevator. The mechanism of the dislocation is simple. When the mouth is opened, the interarticular fibro-cartilage with the condyle glides forwards on to the articular eminence: if this movement be continued too far, and the external pterygoid muscle contract forcibly at the same time, the condyle slips forward into the zygomatic fossa, the coronoid process hitching against the malar bone, the axis of the ramus being directed obliquely backwards, and the dislocation being thus complete. In this way both condyles may be displaced, or only one.

When the dislocation is *Bilateral*, both condyles being displaced from the glenoid cavities, the signs are as follows. The incisor teeth of the lower jaw are separated from those of the upper by a marked interval; the mouth consequently cannot be closed, but is kept more or less widely open. The extent of the separation between the incisor teeth varies from half an inch to an inch and a half. The degree will, I believe, depend on whether the coronoid process is fixed against the malar bone, or has slipped beyond this so as to admit of the displaced bone being received into the sigmoid notch. In the first case, it would be considerably greater than in the second. Deglutition and speech are impaired, the labial consonants not being pronounced; there is dribbling of the saliva over the lower lip, the chin is lengthened, and the lower line of teeth advanced about half an inch beyond those of the upper jaw; the cheeks are flattened, and there is a depression in front of the *meatus auditorius externus*. There is also an oblong prominence in the temporal fossa between the eye and the ear. If the dislocation be left unreduced, the patient slowly regains some power of movement over the jaw; he gradually approximates the lips, and, after a length of time, may even be enabled to bring the lines of teeth into apposition, especially posteriorly.

In the *Unilateral* dislocation, where one condyle only is displaced, the axis of the lower jaw is directed towards the opposite side to that on which the displacement exists; and the general signs are the same, but in a less marked degree, as those which are met with when both sides are dislocated. The hollow before the *meatus* on the injured side is, however, well marked, and serves to point out the seat and nature of the displacement, the diagnosis of

which is not always readily made ; indeed, R. W. Smith states that he has seen attempts at reduction applied to the uninjured side.

Sir A. Cooper has described a *Subluxation* of the jaw, most frequently met with in young and delicate women, in which the head of the bone appears to slip before the interarticular cartilage, so as to prevent the mouth from being closed. Most commonly the natural efforts of the part are sufficient to return the head of the bone into the glenoid cavity with a loud snap, or a cracking noise.

The *Reduction* of a dislocated jaw is easily effected ; it being only necessary to push the angle of the bone downwards and backwards, so as to disentangle the coronoid process from under the zygomatic arch, at the same time that the chin is raised by the surgeon's fingers, in order that the temporal and pterygoid muscles may draw the head of the bone into its proper position. The reduction is best effected by the surgeon standing before the patient and applying his thumbs, well protected with a thick napkin, to the molar teeth on each side, and thus depressing the angle of the jaw forcibly, at the same time that he raises the chin by means of his fingers spread out and placed underneath it. The bone is then returned into its place with so forcible a snap that, unless care be taken, or the thumbs be well covered up, they may be severely bitten. When one condyle only is luxated, the efforts at reduction should be applied to the injured side only. In the cases of subluxation, Sir A. Cooper recommends a tonic plan of constitutional treatment, such as iron, valerian, and shower-baths ; to this I have found the application of a series of blisters over the articulation an useful addition.

After the reduction, the four-tailed bandage should be applied, as in cases of fracture of the jaw : and for several days the patient must not be allowed to talk, or to eat any solid food, lest the displacement return, which it always has a great tendency to do. Very old dislocations of this bone may be reduced by the process just now described. Thus Stromeyer replaced one at the end of thirty-five, and Donovan one at the end of ninety-eight days.

Congenital Dislocation of one Condyle of the Lower Jaw is a remarkable and rare condition, for an acquaintance with which we are chiefly indebted to R. W. Smith. In this condition there is a singular distortion of countenance. The osseous and muscular structures on the dislocated side are atrophied, and the teeth of the upper jaw project beyond those of the lower, contrary to what occurs in the accidental dislocation ; the mouth can be closed, speech is perfect, and there is no dribbling of saliva. Congenital dislocation of both condyles has not yet been observed.

DISLOCATIONS OF THE CLAVICLE are rarely met with in comparison to the frequency of fractures of this bone, owing doubtless to the short and firm ligaments by which it is attached to the sternum and acromion, and to any force that is applied to it being usually received in a line that corresponds to its axis, thus causing it to be bent or broken rather than luxated.

Either the sternal or the acromial end of the clavicle may be dislocated, and the simultaneous displacement of both has even been observed.

1. The *Sternal End of the Clavicle* may be luxated in a direction *forwards*, *backwards*, or *upwards*, being thrown before, behind, or above the sternum.

In the dislocation *Forwards*, the end of the bone can be felt in its new position, the point of the shoulder is approximated to the mesial line, and the depressions above and below the clavicle are strongly defined. It is occasioned by blows upon the shoulder, by bending this part forcibly backwards, or by violence applied to the elbow whilst the arm is raised from the side.

This dislocation, which is amongst the most frequent to which the clavicle

is subject, may readily be reduced by pushing the shoulder outwards and bending it backwards. The principal difficulty in the treatment consists in preventing the return of the displacement, owing to the shallowness of the articular surface upon which the clavicle lodges. With this view, a pad and a figure-of-8 bandage must be firmly applied upon the displaced end of the bone.

The dislocation *Upwards* is of extremely rare occurrence. The signs in the two recorded cases were so evident as not to lead to any difficulty in the diagnosis of the accident, the projection of the sternal end of the clavicle in its new situation being subcutaneous, and at once cognisable to the touch. In the treatment, a bandage and pad, with elevation of the elbow, brought the bone into good position.

The dislocation *Backwards* is not of common occurrence: though, according to Nelaton, there are at least ten or a dozen cases on record. This luxation appears generally to have resulted from the point of the shoulder being driven upwards, or from the hand being violently drawn forwards. It has also been observed to result from the direct pressure of the clavicle backwards, as by the kick of a horse, and has occurred as a secondary consequence of curvature of the spine.

The *Signs* are those that usually attend a dislocated clavicle—shortening of the shoulder, and deformity about the upper part of the sternum; but, besides these, a special train of symptoms is occasioned, by the pressure of the displaced bone upon the trachea, œsophagus, and vessels of the neck. Difficulty in breathing and swallowing, with congestion of the head giving rise even to a semicomatose state, may be produced to such an extent as to require removal of the end of the bone, as happened in a case related by Sir A. Cooper, in which the surgeon was obliged to saw off the dislocated end. In some cases, the end of the bone is thrown upwards as well as backwards; in others, it takes rather a downward direction.

In the *Treatment* of this dislocation, it is easy to effect the reduction of the bone by making a fulcrum of the fist in the axilla, and then bringing the elbow well to the side, at the same time that an assistant puts his knee between the patient's shoulders and bends them back; but it is difficult to retain the bone in proper position. To fulfil this object, the figure-of-8 bandage tightly applied to the points of the shoulders, and crossed over a large pad placed in the middle of the back, will give the most efficient support to the part, the elbow being at the same time well fixed to the side and drawn back.

2. The dislocations of the *Outer End of the Clavicle* are more commonly met with than those just described. The most frequent accident of this description is that in which the bone is thrown upon the *Upper Surface of the Acromion*, or upon the *Anterior Part of the Spine of the Scapula*. In several cases of this accident which have of late years presented themselves at University College Hospital, there has been no difficulty whatever in the diagnosis. The prominence formed by the displaced bone upon the upper surface of the acromion, the narrowing of the distance from the mesial line to the point of the shoulder, the facility of the reduction of the dislocation, and the tension of the clavicular portion of the trapezius muscle, indicate the nature of the accident (Fig. 117). The *Treatment* of this injury is by no means satisfactory. It is easy enough to effect reduction, but there is in many cases a great and, indeed, an unconquerable tendency to the return of the displacement. This is partly owing to the shallowness of the articular surface, partly to the tension of the trapezius, by which the acromial end of the bone is drawn upwards and outwards. Reduction is best main-

tained by the application of an axillary pad, and the same method of treatment as in fracture of the clavicle (Fig. 99). When, however, there



Fig. 117.—Dislocation of the Clavicle on the Acromion.

is a constant tendency to a return of the displacement, M. Laugier has found that Petit's tourniquet, strapped from the shoulder to the elbow, and properly tightened, keeps the bone in good position.

The outer end of the clavicle has been dislocated *Under the Acromion* by the application of direct violence to the end of the bone. This form of displacement is very rare; several instances have, however, been mentioned of late in the journals. The diagnosis is easy, simple digital examination pointing out the nature of the accident; and the treatment must be conducted in the same way as that of fractured clavicle.

The acromial end of the clavicle has been known to be displaced *Underneath the Coracoid Process*. Here, also, simple examination and the clavicular bandage suffice for diagnosis and treatment.

The only instance of *Simultaneous Dislocation of both ends of the Clavicle* with which I am acquainted has been reported by Richerand.

DISLOCATION OF THE SCAPULA.—The *Lower Angle and Dorsal Border of the Scapula* is occasionally the seat of a very remarkable kind of displacement, in consequence of which it projects at a considerable angle from the trunk, giving a winged appearance to the back.

The cause of this peculiar displacement is somewhat obscure: by some it is considered to be dependent upon the bone slipping away from under the posterior edge of the latissimus dorsi muscle; by others again, and apparently with more reason, it is regarded as owing to paralysis of the serratus magnus. Whether this be dependent upon some morbid condition of the muscle itself, as Dr. Jacob supposes, or on a paralysed state of the long thoracic nerve, as Nélaton thinks, can scarcely be determined. In such cases as these, I have seen some benefit derived from the endermic application of strychnine on a blistered surface, and afterwards support by means of a properly constructed apparatus.

DISLOCATIONS OF THE SHOULDER-JOINT occur far more frequently than those of any other. Their pathology and treatment have been so clearly elucidated by Sir A. Cooper, that there is little left for subsequent writers but to follow the descriptions given by that great surgeon; though several of the modern French surgeons, especially Velpeau, Malgaigne, and Goyrand, have thrown some new light on the subject. The reason of the frequency of these dislocations is to be found in the shallowness of the glenoid cavity, the large size and rounded shape of the head of the humerus, and the weakness of the ligaments; but, above all, in the extent and force of the movements to which the joint is subjected. These displacements indeed would be much more frequent than they even are, were it not for the protection afforded to the joint by the osseous and ligamentous arch formed by the coracoid process and acromion with their ligaments, the great strength of the capsular muscles and their close connection with the joint, and the support given by the tension of the long head of the biceps over its weakest part, but the principal obstacle to dislocation is the mobility of the scapula, enabling all movements communicated to the hand and arm to react upon that bone.

The Signs of dislocation of the shoulder-joint are sufficiently obvious, varying, however, according to the nature of the injury. In all cases there are six common signs, viz:—1, a flattening of the shoulder; 2, a hollow under the acromion; 3, an apparent projection of this process, with hollow tension of the deltoid; 4, the presence of the head of the bone in an abnormal situation; 5, rigidity; and 6, pain about the shoulder.

The shoulder-joint is susceptible of four dislocations. Of these, according to Sir A. Cooper, three are complete, and the fourth partial. I think, however, that on examination it will be found that the so-called *partial* dislocation is in reality a complete one. The directions in which the head of the humerus may be thrown are—1, *inwards and slightly downwards* beneath the coracoid process (Fig. 120); 2, *forwards and inwards* beneath the clavicle (Fig. 119); 3, *backwards and downwards* under the spine of the scapula



DISLOCATIONS OF THE HEAD OF THE HUMERUS.

Fig. 118—Subglenoid. Fig. 119—Subclavicular. Fig. 120—Subcoracoid. Fig. 121—Subspinous (Fig. 121); 4, *downwards and slightly inwards* under the glenoid cavity (Fig. 118). Thus three dislocations are more or less inwards, one only being backwards or outwards.

1. *Subcoracoid Dislocation.*—In the case of incomplete dislocation reported by Sir A. Cooper, the head of the bone was found to be thrown out of the glenoid cavity, lying under the coracoid process upon the anterior part of the neck of the scapula (Fig. 120); the capsular muscles were not torn, but the long head of the biceps had been ruptured. The description given by Sir A. Cooper, and the illustrative plate in his work on *Dislocations*, appear to point to a form of injury of the shoulder-joint which has of late years been specially described by the French surgeons as a variety of the dislocation downwards; that form of displacement, indeed, which by Beyer has been described as the dislocation “inwards,” by Maigne as the “subcoracoid” luxation, and by Velpeau as the “subscapular” dislocation; in which the head of the humerus is placed in front of the neck of the scapula, and underneath the subscapular muscle. In this dislocation the head of the bone, instead of being thrown, as in the subglenoid, downwards and slightly inwards, is thrown inwards either directly or slightly downwards as well. Why Sir A. Cooper described this as a *partial* dislocation, I do not understand; for not only was there rupture of the capsule and of the long tendon of the biceps, but the woodcut at page 401 of the last edition of his work shows clearly that the head of the bone had formed a new articular cavity for itself, in the subscapular fossa, being apparently completely thrown out of the glenoid cavity.

There is here less deformity than in the other luxations, the acromion not forming so distinct a projection (Fig. 122). The limb is usually somewhat

lengthened, but at times is actually shortened, the elbow being usually carried backwards and always slightly away from the side; the head of the bone is placed deeply in the upper and inner part of the axilla, and cannot always be very distinctly felt, owing to its being thickly covered with soft parts, by the coracobrachialis as well as by the pectorals; rotation of the arm and elevation of the elbow being usually required in order that it may be detected.



Fig. 122.—Subcoracoid Dislocation of Humerus.

In this dislocation, the head of the humerus can be felt and seen under the pectoral muscles beneath the clavicle; the arm is shortened, the axis of the limb being directed towards its head, and the elbow is a good deal separated from the side and thrown back.



Fig. 123.—Subglenoid Dislocation.

bone lies in the axilla, resting against the inferior costa of the scapula below the glenoid cavity, and lodged between the subscapular muscle and the long portion of the triceps. In it the tendon of the subscapular muscle

2. In the dislocation *Forwards*, or the *Subclavicular* (Fig. 119), the head of the bone is thrown on the inner side of the coracoid process, lying upon the second and third ribs under the pectoral muscles, and immediately below the clavicle. In a case recorded by Mr. Curling, the infraspinatus and subscapularis muscles were torn away from the tubercles of the humerus, and the *teres minor* partially lacerated; the capsule being completely separated from the neck of the bone, which pressed forcibly upon the axillary vessels and nerves. In two cases which I have had an opportunity of examining after death, the great tubercle was torn away from the head of the bone, with much laceration of the capsule and extensive extravasation, but the external rotator muscles were not ruptured.

3. In the dislocation *Backwards*, or the *Subspinous* (Fig. 121), the head of the humerus lies behind the glenoid cavity, and below the spine of the scapula, between the infraspinatus and *teres minor* muscles. Mr. Key found the tendon of the subscapularis torn across, together with the internal portion of the capsular ligament, the *supraspinatus* and the long head of the *biceps* being stretched, but not ruptured.

When the head of the bone is dislocated below the spine of the scapula, it can be felt and seen there, more especially when the arm is rotated. The axis of the limb is altered, being directed backwards nearly horizontally; the elbow is raised from the side, to which it cannot be approximated, and is carried forwards and somewhat downwards.

4. In the dislocation *Downwards*, or the *Subglenoid* (Fig. 123), the head of the

is commonly torn near its insertion into the lesser tubercle of the humerus, and the capsular ligament is largely lacerated. The supraspinatus muscle may also be torn through, or a portion of the great tubercle of the humerus detached, and the rest of the capsular muscles put greatly on the stretch. The axillary artery and plexus of nerves are compressed and stretched by the dislocated head of the bone, so that a severe numb pain is commonly experienced in the hand and arm. The compression of the artery is so great that the circulation through the limb is completely arrested. Thus I saw remarkably illustrated in a patient under my care who had a dislocation downwards of the head of the humerus, with a severe lacerated wound of the forearm, dividing the radial and ulnar arteries. So long as the dislocation remained unreduced, no hemorrhage took place; but so soon as the head of the bone was replaced, the injured arteries bled freely.

The head of the bone can usually be readily felt in the axilla, at its anterior and under part; the arm is lengthened to the extent of about an inch, the forearm is usually somewhat bent, and the fingers are often unclenched, in consequence of the pressure of the head of the bone on the axillary plexus. The elbow is separated from the trunk and carried somewhat backwards, but can be approximated to the side. If the head of the bone cannot be felt in the axilla, its presence there may be ascertained, as Cooper directs, by raising the elbow, when it at once becomes perceptible.

It appears to me that the only dislocation of the humerus to which the term *partial* is strictly applicable, is that which has been described by Mr. Soden, in which the long tendon of the biceps is displaced from its groove or ruptured, and the head of the bone is thrown upwards and forwards under the coracoid process, but not out of the glenoid cavity. It is to this form of displacement also that Mr. Callaway seems disposed to confine the term *partial*.

In this partial dislocation the signs do not appear to be very evident. In Mr. Soden's case there was slight flattening of the outer and posterior parts of the joint, and the head of the bone appeared to be drawn higher up in the glenoid cavity than usual. There was great pain induced by any movement of the biceps muscle; and, on attempting any overhand motions, the head of the bone became locked by the acromion.

Cause.—Dislocations of the shoulder-joint are almost invariably the result of falls upon the hand or elbow; the particular variety of dislocation depending upon the direction of the shock communicated to the arm, and the position of the limb at the time of receiving it. On this account we almost invariably find the displacement in a direction inwards and downwards. When a person saves himself in falling with his arms widely stretched out, the head of the bone is driven with all the force of a long lever against the lower and inner portion of the capsule, which, being ruptured in this its weakest part, allows the bone to be thrown upon or to the inside of the inferior costa of the scapula, and thus into the axilla. When the patient falls upon his elbow, the inner part of the joint is still acted on; but, the leverage not being so great, the head of the bone is thrown upwards or forwards under the clavicle. This dislocation is also often the result of direct violence applied to the shoulder.

The dislocation backwards can only take place when the arm happens to receive the shock at the time when it is stretched across the chest. As this is an unusual position for any injury to be received in, this dislocation is particularly rare. An obstacle to this displacement may also be found in the great strength of the outer portion of the capsule of the joint, as compared with the inner.

Relative Frequency.—Sir A. Cooper states that the dislocation "into the

axilla" is the more frequent form of accident. This opinion is supported by that of most English surgeons. Malgaigne, and more recently Mr. Flower, have expressed the opinion that the subcoracoid is the most common form of this accident. Mr. Flower, who has very ably investigated this subject, finds that of forty-one specimens in the different London museums, thirty-one are undoubtedly *subcoracoid*, and that of fifty recent cases of which he has cognisance, forty-four were of this form. Next in order of frequency comes the *subglenoid*, and then the *subclavicular*, which is somewhat rare. I believe that the subclavicular is, as it were, an exaggerated degree of the subcoracoid; the continuance of the same force, whether mechanical or muscular, which had thrown or drawn the head of the bone to the inner side of the coracoid process, carrying it upwards under the centre of the clavicle. The displacement of the head of the bone under the spine of the scapula is so rare, that Sir A. Cooper met with two cases only of it; several cases have occurred at the University College Hospital, which were reduced without difficulty.

Diagnosis.—Dislocations of the humerus may readily be diagnosed from fractures of the anatomical and surgical neck of the bone, by the existence of the signs which are common to all luxations, and by the absence of crepitus. In fractures in this situation also the glenoid cavity always continues to be occupied by the head of the bone. The existence of crepitus, of slight shortening but little alteration in the axis of the limb, and no correspondence between this and the position of its head, are additional signs of value in establishing the diagnosis. *Paralysis of the deltoid from a blow* may simulate a dislocation, the shoulder being flattened and the acromion projecting; but here the mobility of the joint, and the presence of the head of the bone in the glenoid cavity, establish the absence of dislocation.

The *Reduction* of a dislocated humerus may be conducted on three different plans:—by the heel in the axilla; by the knee; or by drawing the arm



Fig. 124.—Reduction of Dislocated Shoulder joint, by the Heel in the Axilla.

upwards. Whichever plan is adopted the patient should, if strong, be put under the influence of chloroform; when his muscles are paralysed by this agent but little force is required to effect the reduction, the surgeon's unaided

strength usually sufficing for this purpose. If more power, however, should be required than he can exercise, extension may be made by assistants drawing upon a towel properly fixed round the lower end of the humerus, or else by the pulleys attached to the same part of the limb.

1. The reduction of the dislocation *by the heel in the axilla* is certainly the easiest procedure in ordinary cases. In adopting this plan, the patient is laid upon his back upon a low bed or couch; the surgeon, seating himself upon the edge of this on the same side as the dislocated arm, takes the limb by the wrist, and, fixing one foot firmly upon the ground, places the other, merely covered with the stocking, well up into the axilla, so that the heel may press against the lower border of the scapula, and the ball of the foot act upon the humerus (Fig. 124). He then draws the limb steadily downwards, and, when it is disengaged to a sufficient extent, brings the hand across the patient, using his foot as a fulcrum, by which the head of the bone may be reduced by being pushed upwards and outwards. This mode of reduction is especially serviceable in ordinary dislocations into the axilla, and in those under the clavicle. In the latter, however, it will be necessary to draw the arm more obliquely downwards and backwards, and to press the foot somewhat forwards upon the head of the bone, after it has been disengaged by being brought below the coracoid process.

2. The reduction *by the knee in the axilla* is precisely the same in principle as the last, though not by any means so good a plan; the knee being too large, and not following the movements of the humerus so readily as the foot. In effecting the reduction by this means, the patient is seated on a chair; and the surgeon, standing by his side and resting one foot upon the seat, places his knee in the axilla. He then seizes the patient's arm above the elbow with his right hand, and steadying the acromion with his left, draws the limb well down, and brings it across the knee: the head of the bone is thus reduced.

3. In some cases reduction is easily effected by laying the patient on his back, when the surgeon, sitting behind him, *raises the arm perpendicularly* by the side of the head, at the same time that he fixes the acromion. In this way the head of the bone is brought directly upwards into the glenoid cavity.

If the patient be very muscular, or the dislocation of old standing, it may be necessary to have recourse to the *pulleys* in order to effect reduction. In applying these the scapula must be firmly fixed, the counterextension being made by passing the patient's arm through a slit in the middle of a jack-towel, which should be fixed firmly to a hook or staple in the wall. The extending force may then be applied immediately above the elbow; and traction being made slowly and steadily in the direction of the axis of the limb. The head of the bone should be directed to the glenoid cavity by the pressure of the surgeon's hands, so soon as it has come on a level with it. In this way dislocations of the humerus of many weeks' or even months' standing have been successfully reduced; but in employing these powerful means, especially under the influence of chloroform, the surgeon should always bear in mind that, unless care be taken, serious mischief, even laceration of the axillary artery, may result. After dislocation of the humerus has been reduced, the limb should be bandaged to the side and supported in a sling, and if inflammation occur about the joint, recourse may be had to leeches and evaporating lotions.

After reduction, there is a tendency for the head of the bone to be drawn upwards and outwards under and against the acromion, owing evidently to the *latissimus* and *coraco-brachialis* muscles not being any longer counter-

balanced in their actions by those that have been separated from the head of the bone.

A *simple dislocation of the head of the humerus, complicated with rupture of the axillary artery* and the formation of a diffused axillary aneurism, is a condition of things as serious as it is fortunately rare. In a case of this kind, Dr. R. Adams, after reducing the dislocation, ligatured the subclavian artery, the patient recovering; and this would be the proper practice to pursue in similar cases.

Compound Dislocation of the Head of the Humerus is a rare accident. I have, however, seen two cases of it, and in two directions: downwards—*Subglenoid*, and inwards—*Subcoracoid*. In both cases reduction was effected, and the patients did well. In it, even though the injury be extensive, it is better not to amputate if the brachial vessels and nerves be uninjured. The limb may be saved by reducing the bone at once; after this the wound should be closed and dressed lightly, and kept cool by constant irrigation. If the axillary artery be ruptured at the same time, either completely or through its inner and middle coats, obstruction to the arterial circulation of the arm will ensue, and amputation must be performed through the articulation.

A very serious accident, and apparently difficult to treat, consists in the complication of a *dislocation of the humerus with fracture through the epiphysis of the displaced bone*. A case of this kind, to which I was called, is described at page 293.

When the dislocation is *complicated with a fracture of the shaft of the bone*, it should be reduced at once by putting the fracture up very firmly, and then attempting the reduction by one of the usual methods. In the cases to which I have already referred (p. 293), I succeeded without difficulty by means of the heel in the axilla. The fracture must then be treated by lateral splints.

Congenital Dislocations of the Shoulder-joint have only of late years attracted attention. Dr. R. W. Smith has ascertained, by *post-mortem* examination, the existence of two varieties of this condition—the *subcoracoid* and *subacromial* luxations. In these there is wasting of the muscles of the shoulder and arm, the motions of which are extremely limited, whilst those of the scapula are preternaturally great. The condition of the bones is also remarkable. In a case of congenital subacromial luxation of both shoulders, there was no trace of a glenoid cavity; but a well-formed socket existed on the outer side of the neck of the scapula, receiving the head of the humerus, which was small and distorted. These dislocations, though existing from birth, usually become more marked as age advances, but are necessarily irremediable, in consequence of the malformation of the osseous structures and the wasting of the muscles.

Old Unreduced Dislocations of the Head of the Humerus are not unfrequently met with. In the majority of these cases there is a considerable amount of pain and immobility about the shoulder at first; but after a time the head of the humerus forms a new bed for itself, and the movements of the arm become freer and less painful, so that eventually a limb useful for all except the over-head movements will result.

In cases of old dislocation of the head of the humerus, the question as to the advisability of attempting reduction always presents itself to the surgeon. As a general rule this should always be attempted under chloroform, in accordance with the principles laid down at p. 290, if only a few weeks have elapsed from the time of the accident, and then it will usually be attended with success. Reduction has been effected in many cases at a much later

period than this; by Mr. Brodhurst, after twenty-five weeks had elapsed; and by Mr. Smith, U.S., after no less a period than seven months in one case, and ten and a half in another. By the use of the subcutaneous division of muscles, &c., Dieffenbach is said to have succeeded in reducing a dislocation of the shoulder after it had existed two years. In many cases, however, at a much earlier period than these, the surgeon will fail, notwithstanding the most persevering attempts at reduction; and, in others again, certain accidents have occurred, which every surgeon should bear in mind, so as to render him cautious in his proceedings.

The accidents that have occurred in attempts at reducing old-standing dislocations of the head of the humerus are such as may arise either from the employment of an undue amount of force, or from the separation of the head of the humerus from the adhesions that it has contracted in its new situation. Amongst the first are laceration and bruising of the skin, subcutaneous cellular tissue, and muscles, with extravasation of blood; amongst the latter are fracture of the humerus, and laceration of the axillary vessels and nerves.

Fracture of the humerus has occurred in the practice of many surgeons of eminence. It has happened to Petit, Pott, Larrey, Bérard, Denonvilliers, and others. The surgical neck of the bone appears to be the part that has usually given way; and the accident has not occurred so much from forcible extension, as in carrying the arm across the chest so as to tilt the head of the bone into its place, when the shaft becomes exposed to fracture by pressure in a transverse direction. The occurrence of such an accident as this necessarily prevents all further attempt at reduction.

Fracture of the ribs by the pressure exercised against the wall of the chest is supposed to have occurred in some cases.

The *extravasation* of a large quantity of blood into the cellular tissue of the axilla has occasionally occurred, without any evidence of the rupture of one of the main vessels of the part. In these cases the swelling has gradually subsided under the employment of ordinary treatment, by rest and evaporating lotions.

More serious by far than this is the *rupture of one of the large blood-vessels* in the axilla. This may happen in two ways: either by the pressure of the surgeon's heel, as happened in a case reported by Hamilton, in which an attempt had been made to reduce a dislocation of old standing by this means, the surgeon unfortunately forgetting to remove his boot, and thus continuing and lacerating the artery. Or, it may occur from the humerus having become adherent to the vessel, and lacerating this when torn away. The instances on record of *laceration of the axillary artery*, and the consequent formation of a *diffused traumatic aneurism* in the axilla, in the reduction of old dislocations, are so numerous—there being at least twelve cases in the records of surgery—as to act as a warning to the surgeon not to employ too much force in cases of this kind.

In the great majority of these cases—in at least ten out of the twelve—the *diffused traumatic aneurism* appeared immediately after the employment of forcible and long-continued extension. In the remaining two instances, the *aneurismal tumour* did not appear until after a lapse of time. In Dupuytren's case a woman, sixty years of age, had a dislocation into the axilla of six weeks' standing reduced. Two or three months after this, a tumour appeared in the armpit. This was mistaken for an abscess, and opened; arterial hæmorrhage ensued, and the patient died on the eighth day, from secondary bleeding. In Hamilton's case the patient, also an old woman, had a subglenoid dislocation which was easily reduced. But an aneurism appeared in the

axilla, which, three months after the reduction, compelled that distinguished surgeon to tie the subclavian. Both these aneurisms were probably circumscribed.

Dupuytren's case was not the only one in which the fatal mistake was committed of opening the aneurism in the axilla—the same was done by Polletan, who mistook the tumour for an emphysema; the result being of necessity fatal. In cases reported by Verduc, Petit, Platner, and Leubet, the aneurism was allowed to run its course unchecked by efficient surgical treatment, and in every instance proved fatal by the sac giving way, and secondary hemorrhage ensuing. Sir C. Bell records a case that occurred at the Newcastle Infirmary, in which the pectoral muscles as well as the artery were torn, and immediate amputation became necessary. In four cases the subclavian artery has been ligatured. All these happened in America; two to Gibson, one to Blackman of Cincinnati, and one to Warren. Three of these cases proved fatal by secondary hemorrhage, Warren's being the only one in which recovery took place.

What Treatment should be adopted in this distressing accident? If the aneurism be left to itself, or be treated by inefficient means, it must necessarily prove fatal by its rupture or sloughing and secondary hemorrhage. The ligature of the subclavian is not very promising, as a fatal result occurred in three out of the four cases in which it has been tried for diffuse aneurism, Nélaton's case having been circumscribed. Under these circumstances, it appears to me that it would be wiser to apply to these cases the usual principle of treatment that is adopted in cases of diffused axillary aneurism from other causes; viz., to compress the subclavian, lay open the sac, turn out coagula, and tie the torn artery at the seat of injury.

In one case, the dislocation being of twenty days' standing, and the patient a female 26 years old, Froriep states that reduction was followed by sudden and extensive tumefaction of the axilla, syncope, and death in an hour and a half. A *post-mortem* examination disclosed lacerations of the axillary vein. No mention is made of any internal injury to account for death.

Injury to the axillary nerves during reduction leading to paralysis of the arm has also been described.

Besides these accidents, other evil consequences have occasionally followed prolonged attempts at reducing old dislocations of the humerus, such as sudden death from syncope, and exhaustion.

In the event of the surgeon being unsuccessful in his attempts at reduction, he must endeavour, by means of frictions and passive motion, to restore, as far as practicable, the utility of the limb. In some of these cases of old unreduced dislocation, I have succeeded in very materially improving its condition by putting the patient under the influence of chloroform, and moving the limb freely to and fro so as to loosen, stretch, and break up the adhesions about the head of the bone; and it is in this way that attempts at reduction, even though unsuccessful in replacing the head of the bone, are often of great use in improving the mobility of the limb.

DISLOCATIONS OF THE ELBOW are by no means unfrequent accidents; and, as they are often occasioned by direct violence, in consequence of which much swelling speedily sets in, their signs are frequently obscured, and the diagnosis is rendered proportionately difficult; more especially when the dislocation happens to be complicated with fracture of the articular ends of the bones. In these cases, indeed, it is only by a correct acquaintance with the normal relations of the osseous points, and by a comparison between those of opposite sides, that the surgeon can detect the true nature of the injury.

The *Varieties* of dislocation of the elbow-joint are very numerous, either both bones of the forearm or only one being implicated.

1. *Both Bones*.—The most common dislocation is that in which both bones are thrown *Backwards*, with or without fracture of the coronoid process. This injury is readily recognised by the projection backwards of the olecranon, carrying with it the tendon of the triceps. The articular end of the humerus also can be felt projecting in front of the elbow. When the coronoid process is not broken off, it is fixed against the posterior surface of the humerus, the forearm being immovably placed in its new position. When this process is fractured, there is great mobility about the joint, and crepitation may be felt as the arm is drawn forwards.

Dislocation of both bones *Forwards* can scarcely occur without fracture of the olecranon. Rare as this accident must be, there are at least four cases on record by Colston, Lana, Delpech, and Canton, in which the bones have been so displaced without this process being broken. In this injury the elongation of the forearm, the projection of the condyles of the humerus, and the depression of the posterior surface of this bone, render the diagnosis sufficiently easy. When the olecranon is broken off, there is elongation of the forearm and great mobility, but the detached fragment can be felt behind the humerus.

The *Lateral* dislocation of the bones of the forearm is almost invariably incomplete; either the head of the radius hitching against the internal condyle, or the ulna coming into contact with the external one. Complete lateral dislocation of the bones of the forearm is excessively rare: the only instance with which I am acquainted is a luxation outwards, reported by Nelaton, of which he has given a woodcut.

The ulna or radius alone may be displaced; and, in some cases, both bones are dislocated, but in opposite directions, thus complicating considerably the nature of the accident.

2. *Ulna*.—The only dislocation to which the ulna alone is subject is that in a direction *Backwards*. This seldom happens without more or less dislocation of the head of the radius. When it occurs, it may be recognised by the projection of the olecranon backwards, and by the head of the radius being felt in its normal situation, or nearly so, during the movements of pronation and supination. In the majority of cases the coronoid process is fractured, at the same time causing ready disappearance and recurrence of the dislocation, with crepitus.

3. *Radius*.—The radius alone may be dislocated *forwards, backwards, or outwards*. The dislocation *Forwards* is certainly the most common. In the many instances of it that I have seen, it has resulted from a fall on the palm of the hand, by which, the lower end of the radius being driven backwards, the upper end is tilted forwards with the whole force of the leverage of the bone, and in this way, rupturing the annular ligament, is thrown against the external condyle. The signs of this displacement are the following:—The forearm is slightly flexed, and in a mid state between pronation and supination; any attempt at the latter position occasions great pain, as does also the endeavour to straighten the arm. The elbow can only be bent at an obtuse angle, in consequence of the head of the radius resting against the lower end of the humerus (Figs. 125, 127). On rotating the radius much pain is experienced, and the head of the bone can be felt to roll on the fore part of the humerus, the external condyles of which project unnaturally. The hand and arm can be fully pronated, but cannot be supinated more than half way. The whole of the outer side of the arm is deformed, being carried somewhat upwards (Fig. 126). The rupture of the annular ligament in this

dislocation makes it very difficult to keep the head of the radius properly fixed, so as to prevent a recurrence of the displacement.



Fig. 125.—Dislocation of the Radius forwards. Limit of Power of Bending the Arm.



Fig. 126.—Dislocation of the Radius forwards: Deformity of Outer Side of Arm.



Fig. 127.—Position of the Bones in Dislocation of the Radius forwards.

In some cases, and indeed not unfrequently, there is *incomplete dislocation of the radius forwards*, arising either from falls upon the hand, or from violent twists of the forearm. In these we have the preceding signs, though to a less marked degree. The most characteristic symptom, however, is the inability on the part of the patient to flex the forearm upon the arm. This he can never do to a greater extent than to bring the elbow to a right angle (Fig. 125). On being told to touch the tip of his shoulder with his forefinger, he will find it impossible to do so.

The dislocation of the radius *Backwards* is of extremely rare occurrence; it may always be recognised by the head of that bone being felt subcutaneously behind the external condyle; the movements of the elbow, and of the radius especially, being at the same time very limited and painful.

Dislocation of the radius *Outwards* is of more frequent occurrence than the last injury, the head of the bone being thrown on the outer side of the external condyle, where it is felt under the skin, rolling as the hand is moved. The natural motions of the joint are of course greatly interfered with.

The radius and ulna are sometimes displaced in *Opposite Directions*, the ulna being thrown *backwards*, and the radius *forwards*. This injury, of which I have seen two instances at the Hospital, usually results from heavy falls upon the hand, with a wrench of the limb at the same time, as when a person is thrown out of a carriage, or lights upon his hands, in consequence of which the bones are twisted and displaced in opposite directions. The deformity is

of course great, but is readily recognised by the combination of the characters of the two forms of displacement, provided an examination be made before the swelling has come on, which rapidly sets in.

Complications.—Dislocations of the elbow-joint are very frequently complicated with fracture of one or other condyle of the humerus, of the olecranon, and, as we have already seen in displacement of the ulna, of the coronoid process. In these complicated injuries an exact diagnosis is often extremely difficult, owing to the looseness and mobility of the parts, and to the great tumefaction that accompanies accidents of this description. It is in these cases that a good knowledge of the relative bearing of the different osseous points, aided by a comparative examination of the opposite limb, will alone enable the surgeon to effect a proper diagnosis of the nature of the injury.

The mode of *Reduction* in dislocations of the elbow-joint varies according as the ulna is displaced or not. When the ulna is dislocated, in whatever direction it may be thrown, and whether the radius be displaced at the same time or not, we shall find that the great obstacle to reduction is the hitching of the processes of the bone against the articular end of the humerus. If either the olecranon or coronoid process be fractured, this entanglement cannot take place, and the joint then slips into its position without difficulty, though it is very difficult to maintain it there. The reduction of the displaced ulna, when uncomplicated by fracture, may always be effected, as Sir A. Cooper has recommended, by bending the arm over the knee. The patient being seated on a chair, the surgeon rests one foot upon the seat, and, placing the knee in the bend of the injured elbow, grasps the forearm with both hands (Fig. 128); fixing the arm, he presses the knee firmly against the inner aspect of the forearm, so as to disengage the ulna from the lower end of the humerus, and at the same time he bends or pushes the forearm into proper position, into which, indeed, it has a tendency to return by the action of its own muscles, so soon as the opposing osseous surfaces are separated.



Fig. 128.—Dislocation of the Ulna. Reduction.

In dislocations of the radius, this movement across the knee is not necessary. All that is required is to fix the upper arm, and then, employing extension from the wrist, to straighten the arm well; when, by bending the elbow at right angles, the head of the radius may be pressed into a proper position.

After reduction has been effected, the limb should be firmly put up in lateral angular splints, the hand being kept semi-prone. If the radius have been displaced, a pad should be applied over its head, so as to prevent a return of the displacement, which is very apt to occur when the orbicular ligament is torn. In the case of dislocation of the radius *forwards*, however, reduction is best maintained by placing the arm in the extended pos-

tion, and applying a straight splint, well padded, along the palmar aspect of the limb. The inflammation which usually results must be combated by the free applications of leeches and of evaporating lotions. When this has subsided, passive motion may be commenced, and frictions and douches employed, so as to remove the stiffness that is apt to be left about the joint.

In those cases in which the dislocation is complicated with fracture of some part of the articular ends, and in which the diagnosis of the precise nature of the injury, owing to the swelling or other causes, has not been very clearly made out, the joint should be placed in as good a position as possible, by a process of traction, flexion, and moulding, so as to bring the osseous points into proper bearing with one another; the angular splints must then be applied, and local antiphlogistic treatment had recourse to. At the end of a month or five weeks passive motion may be commenced, lest permanent rigidity come on, which is very apt to supervene.

Compound Dislocations of the Elbow are always very serious injuries. In their treatment, the surgeon will usually have to decide between resection of the articular ends of the displaced bones and amputation of the arm. He will be guided in the course he takes by the amount of mischief done to the soft parts. If these be simply lacerated over the posterior aspect of the joint—the dislocation, when compound, being almost invariably backwards—the wound may be enlarged, and the articular ends removed. Should the soft structures be extensively contused and torn, the brachial artery or the median nerve injured, and the bones fractured as well as dislocated, amputation will be the safer course. In determining on the line of practice, however, the surgeon will be guided by the considerations stated at p. 260, in reference to compound fracture of this joint.

Old standing Dislocations of the Elbow are reduced with much difficulty in all cases in which the ulna is completely displaced, owing rather to the interlocking of the irregular articular surfaces than to muscular contraction. The tendon of the triceps, and even that of the biceps, have been divided in some of these cases of old-standing dislocation of the elbow. This operation, however, is seldom attended by any useful result, the difficulty of reduction not being dependent on the action of these muscles. In those instances in which I have done this operation or seen it adopted, but little, if any, good has resulted; and I have known troublesome sloughing to ensue. As a general rule, I believe that it will be found extremely difficult, even under chloroform and with the aid of the pulleys, to reduce an ulna that has been completely dislocated for more than a month. When the ulna is only partially dislocated, even though the radius be completely displaced, reduction may be effected without much difficulty at a very much later period—it is said, as late as two years after the accident; but here the difficulty is, to maintain the reduction and keep the bone in position, as it has a constant tendency to slip forwards and outwards.

DISLOCATIONS OF THE WRIST are of rare occurrence; so much so, that their existence has been denied by Dupuytren and other modern surgeons of great experience. Although there can be no doubt that fractures of the lower end of the radius, more especially of an impacted character, have often been mistaken for these displacements, yet there can be now no question that they do occasionally, though rarely, occur. Any doubt that may formerly have existed upon this point, in consequence of the want of *post-mortem* examinations, has been in recent years cleared up by the dissections of cases that have been made by Marjolin and Voillemier. The observations of these surgeons, together with those previously made by Sir A. Cooper, and

to show that dislocation of the *Hand and Carpus* from the bones of the forearm may take place either *backwards* or *forwards*. In these dislocations, the displacement takes place between the carpus and the radius.

These accidents are occasioned either by falls on the palm, or by the hand being forcibly bent forwards. In falls on the palm, the hand may be thrown forwards under the bones of the forearm, lying on their palmar aspect. In forcible bending of the hand forwards, there will be a tendency to displacement of it and the carpus backwards on the dorsal aspect of the radius and ulna.

In the *Dislocation of the Hand and Carpus backwards*—the dorsal displacement—there will be shortening of the length of the limb below the elbow, with a large dorsal prominence occasioned by the carpus overlapping the lower end of the radius, which bone will be felt and seen as a projection on the palmar side.

In the other variety of radio-carpal dislocation, the *Hand and Carpus* are thrown forwards under the radius and ulna on their palmar aspect. This

dislocation is illustrated in the accompanying figure taken from a cast sent to me by my friend Mr. Cadge (Fig. 129). In it the projection of the styloid process of the ulna and the lower end of the radius form a concave line on the dorsal aspect, overlapping the carpus, which lies in front or on the palmar side of the radius.



Fig. 129.—Dislocation of the Hand and Carpus forwards.

The *Diagnosis* of these injuries has to be made from sprains of the wrist, and from simple and from impacted fractures of the radius. From sprain of the wrist, the great and prominent deformity will at once enable the surgeon to distinguish a dislocation. From simple fracture of the lower end of the radius, the peculiar deformity, and the absence of crepitus, will afford ready means of diagnosis. It is from the impacted fracture of the lower epiphysis of the radius that it is most difficult to distinguish a dislocation. In the dislocation, however, the general laxity of the wrist-joint, the greater readiness with which the deformity is removed, the peculiar and abrupt swelling, and the absence of obliquity of the hand towards the radial side, will enable the surgeon to distinguish the true nature of the injury.

The *Treatment* of these cases is simple, and in accordance with general principles. Reduction, which is readily effected, must be maintained by the application of antero-posterior splints of sufficient length to take in the hand.

Compound Dislocation of the Wrist, without fracture of the bones of the forearm, is an accident of rare occurrence. In one such case which came under my care in consequence of injury inflicted on the arm by machinery, the hand was thrown forwards, the radius projecting backwards, and the soft structures on the palmar aspect of the joint were so extensively torn through. The *Treatment* of such a case will depend on the amount of injury done to the soft parts. If these be not very extensively injured, an attempt

may be made to save the limb; but if these be widely torn through, the arteries and nerves lacerated, and the tendons perhaps hanging out, amputation will be required, as occurred and was done in the case to which I have just referred. This will be rendered more imperative if the bones of the forearm be comminuted as well.

Congenital Dislocation of the Wrist may take place either forwards or backwards. The limb is in either case greatly deformed. The bones are shortened, and altered in shape, more especially the lower end of the radius. The muscles are also shortened, the extensor tendons forming a sharp angle as they pass over the carpus.

DISLOCATIONS OF SINGLE BONES OF THE CARPUS are by no means of frequent occurrence. The bone that is most commonly displaced is the *Os Magnum*. This accident usually happens from falls, in which the hand is violently bent forwards, in consequence of which this bone starts out from its articulation, projecting as a round hard tumour on the back of the wrist opposite to the metacarpal bone of the middle finger. It may be readily reduced by being pressed upon at the same time that the hand is extended, thus pushing it into proper position. There is, however, a great tendency for this bone to slip out again, leaving considerable weakness of the joint: so much so, that in two cases recorded by Sir A. Cooper, the patients found it necessary to wear artificial supports.

The *Pisiform Bone* is occasionally dislocated upwards. In a case under my care, it was displaced by an effort to lift a heavy weight, and drawn up the arm to a distance of nearly an inch by the flexor carpi ulnaris.

A case some time ago occurred to me, at the Hospital, in which the *Semilunar Bone* was dislocated. The patient in whom this accident happened, had fallen from a height, injuring his spine, and doubling his right hand under him. On examining the wrist, a small hard tumour was felt projecting on its dorsal aspect; it readily disappeared on extending the hand and employing firm pressure, but started up again so soon as the wrist was forcibly fixed. It was evident that this bone belonged to the first row of the carpus, articulating with the radius; and from its size, its position towards the radial side of the carpus, and its shape, which could be very distinctly made out through the integuments, there could be little doubt that it was the semilunar bone.

DISLOCATIONS OF THE METACARPAL BONES.—Besides the above-mentioned dislocations, the *Metacarpal Bones* may possibly, though far more rarely, be dislocated from the carpus. This accident usually happens to a single metacarpal bone; which, in consequence of some extreme degree of violence, is forced out of its bed and is thrown backwards on the carpus. Most frequently this accident is the result of injury and shattering of the hand by gun barrel or powder-flask explosions; and in such cases the metacarpal bone of the *Thumb* is the one that commonly suffers, the dislocation also usually being compound, and complicated with fracture of the bones and extensive palmar laceration. Dislocation of the thumb, however, is rare, though the articulation between this bone and the trapezium appears at first not to be of a character to resist much external violence. This is probably owing in a great measure to the powerful muscles by which the bone is supported in all cases in which the force is applied upon its palmar aspect, as it most frequently is, as well as to the little leverage offered by so short a bone. Luxation, however, of the metacarpal bone of the thumb has been observed to take place forwards as well as backwards, the latter being the most common. The reduction is in general easy, extension being made from the thumb by means of a piece of tape applied round the first phalanx.

Next to the metacarpal bone of the thumb, those of the *index* and *middle* fingers are most liable to dislocation backwards: sometimes complete, at others incomplete.

I am not acquainted with any case on record in which *all* the metacarpal bones have been dislocated from the carpus. The annexed engraving (Fig. 130) from a cast in University College Museum, taken from a patient in the Hospital, in whom I believe that this accident must have occurred; the hand being thrown forwards, and the carpal bones forming a rounded and *convex* prominence on the dorsum. The convex appearance of this corresponds with the outline of the carpal bones, and differs so very remarkably from the concave aspect of the lower end of the radius and ulna, as seen in radio-carpal dislocation (Fig. 129), that I think there can be little doubt as to the nature of the injury sustained by the patient.

The Treatment of such cases will be the same as that for ordinary dislocations of the carpal bones, splints of sufficient length to take in the hand being applied, after reduction, in order to maintain the parts in position.



Fig. 130 — Dislocation of the Metacarpal from the Carpal Bones

DISLOCATIONS OF THE METACARPO-PHALANGEAL ARTICULATIONS are by no means of common occurrence, though occasionally met with. Most frequently the *Proximal Phalanx of the Thumb* is the bone that is dislocated, being thrown *backward* on the metacarpal bone (Fig. 131). The signs of this accident are sufficiently evident, the prominence formed by the articular surfaces being distinctly marked. This dislocation of the proximal phalanx of the thumb has, owing to the difficulty of its reduction, attracted more attention than it would at first appear to deserve. So great has this difficulty been in some cases, as to render the dislocation irreducible, or to compel the surgeon to have recourse to operative interference in order to replace the head of the bone. The obstacle to the ready reduction of this small bone has been attributed to different causes. Thus, Hey supposed that it was owing to the constriction of the neck of the bone between the lateral ligaments of the joint; and Dupuytren entertained a very similar opinion, looking upon the position of these ligaments as the principal source of difficulty. The folding in of the anterior ligament of the joint, and the interposition of a sesamoid bone between the articulating surfaces, have also been looked upon as giving rise to this peculiarity.



Fig. 131 — Dislocation of the Proximal Phalanx of the Thumb.

The more probable explanation, however, appears to be that the neck of the metacarpal bone becomes locked between or constricted by the two terminal attachments of the short flexor of the thumb, which must be carried back over its head, together with the displaced phalanx. The observations of Vidal, Malgaigne, and Ballingall point to this as the cause.

In many cases this dislocation may be reduced readily enough by the surgeon making extension with his fingers simply, and then pushing the

bone into place ; or, better still, after making some traction, by forcibly bending the phalanx towards the palm of the hand. If these means do not suffice, the hand should be fixed, and steady traction then be made from the phalanx, to which, previously protected by a strip of wet wash-leather, a piece of tape has been applied with a clove-hitch knot ; or, if more force be required, the pulleys may be used. In some cases the bone may be replaced by passing the ring of a door-key over the thumb, fixing one side against the projecting head of the phalanx, and then drawing and pressing this into its proper position. If all these means fail, subcutaneous section of the opposing muscle may be practised. If the dislocation be left unreduced, Sir A. Cooper says that the patient may still have a very useful thumb.

In *Compound Dislocation of this joint* the bone may usually readily be replaced ; should there be any difficulty its head must be removed, the dislocation being then reduced with great readiness, and the wound treated in a simple manner. When this dislocation is compound, with much laceration of the integuments, disorganisation and destruction of the joint usually ensue, demanding removal of the end of the thumb.



Fig 132. Dislocation of the Middle Finger

DISLOCATION OF THE PHALANXES rarely occurs ; when met with, these displacements are readily recognised by the deformity they entail (Fig. 132), and are easily reduced by pressure and traction in proper directions. In *Compound Dislocation of the phalanges*, the bone should be replaced, the finger supported by a pasteboard splint, and the wound dressed lightly. In some cases it is necessary to remove the projecting end of bone before this can conveniently be done ; ankylosis then results, a sufficiently useful finger being left.

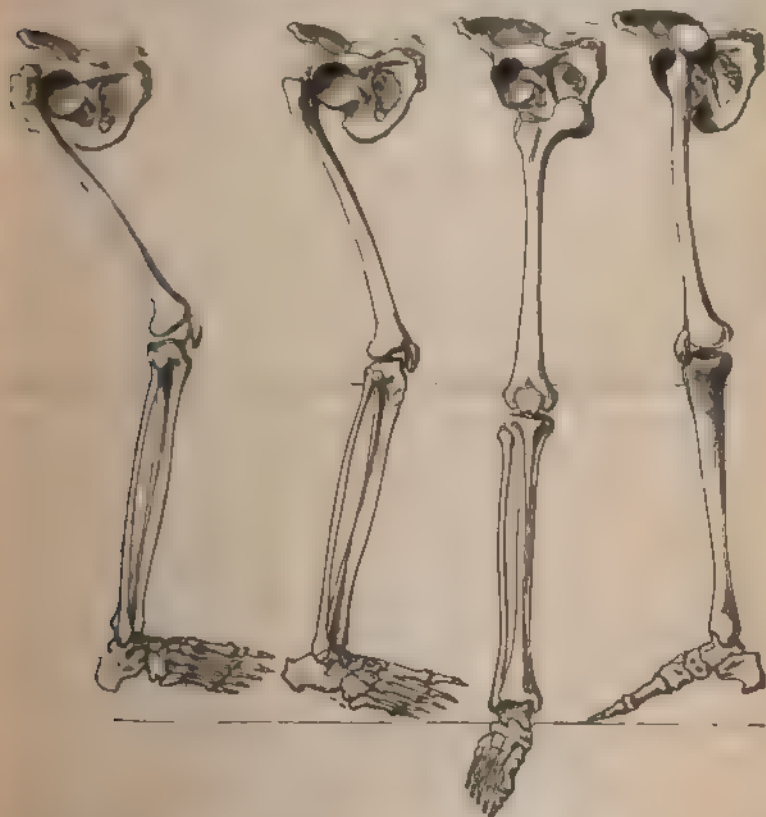
DISLOCATIONS OF THE PELVIS.—It often happens that, in consequence of severe blows upon or compression of the pelvis, the *Symphysis of the Pubic Bones*, or more frequently the *Sacro-liac Articulation*, is displaced. Here the nature of the injury is indicated by the deformity that results ; and the same treatment is required as in fracture of the pelvis, with which these accidents are commonly associated.

The *Coccyx* is sometimes violently bent and almost dislocated *forwards* by falls ; or it may be forcibly bent *backwards* during violent parturient efforts. These accidents may be remedied by manipulation through the rectum ; but are apt to be followed by that painful neuralgic affection *coccydynia*, described at p. 268.

DISLOCATIONS OF THE HIP.—Notwithstanding the great depth of the acetabulum, the complete manner in which the head of the thigh-bone is received into its cavity, the firmness of the capsular ligament, and the great strength of the capsular muscles that surround and support the joint, dislocations of the hip are more frequently met with than those of many other joints that appear less perfectly supported. This is doubtless in a great measure owing to the action, on the head of the femur, of the great length of leverage of the bone itself when external violence is applied to the knee, and of that of the whole length of the lower extremity when the violence is applied to the foot.

The different forms of dislocation of the femur have been expressed with great clearness and precision by Sir A. Cooper, who has shown that its head is most commonly thrown upwards and somewhat backwards, so as to lodge

on the slightly concave surface between the acetabulum and the crista ilii, resting on the gluteus minimus, and having the trochanter turned forwards (Fig. 133); or it may be thrown *downwards* into the foramen ovale, lying upon the obturator externus muscle (Fig. 135); or *forwards and upwards* upon the horizontal branch of the pubic bone under the psoas and iliac muscles, to the outer side of the femoral vessels (Fig. 136). The head of the bone



DISLOCATIONS OF THE HEAD OF THE THIGH BONE

Fig. 133 — Upwards and backwards, on Crista Ilii. Fig. 134 — Backwards into Sacro-sciatic Notch. Fig. 135 — Downwards into Foramen Ovale. Fig. 136 — Forwards and Upwards on the Pubic Bone.

may also be thrown *backwards* into the sacro-sciatic notch, resting upon the pyriformis muscle (Fig. 134). These are the four forms of the dislocation of the hip admitted by Sir A. Cooper as of the more usual character; besides them, however, may be added, as not of very unfrequent occurrence, that form in which the bone is thrown *backwards and somewhat downwards* behind the tuberosity of the ischium. In addition to these, other less common forms of dislocation have been noticed; for instance, one in which the head of the bone lies between the anterior superior and the anterior inferior spinous processes of the ilium, or that in which it has been thrown upon the spine of the ischium.

The extent of mischief done in the soft parts around the joint varies in different dislocations. In all, the capsular ligament is torn; and in most, the

ligamentum teres is ruptured. But Dupuytren and Sédillot both mention cases of dislocation on the dorsum ili in which this ligament escaped without rupture. In the dislocation on the dorsum ili Sir A. Cooper has found the gemelli, obturatores, and quadratus completely torn across, and the pectineus slightly torn. In the dislocation into the sciatic notch, M. Ribard d'Angers has found the gluteus maximus and medius torn, and the gemelli ruptured. In the displacement on the obturator foramen, the pectineus and adductor brevis are torn. In the dislocation on the pubic bone, the extent of injury is more uncertain. In a case related by Sir A. Cooper, Poupert's ligament was torn up, and in another the pectineus and adductors were torn; but whether this was done by the dislocation or by the direct injury that occasioned it, is uncertain.

The signs, causes, and treatment of the different dislocations of the hip differ so greatly from one another that, practically, it becomes necessary to describe each of these displacements as a separate lesion. In considering these, we may reduce the more ordinary dislocations of the hip to three distinct varieties; bearing in mind the other and less usual forms of displacement which may occur. With regard to their relative frequency, Sir A. Cooper says that, of 20 cases of dislocation of the hip, 12 will be on the dorsum ili, 5 on the sciatic notch, 2 on the obturator foramen, and 1 on the pubic bone.

1. The most common dislocation, then, is that in which the head of the bone is thrown *upwards and backwards* upon the dorsum of the ilium, or rather upon that portion of the bone which extends between the acetabulum and the sacro-sciatic notch (Fig. 133). This displacement differs so slightly in its pathology and treatment from the dislocation into the sciatic notch (Fig. 134), described as a distinct variety of the injury by Sir A. Cooper, that I think it is more consistent with the true nature of these accidents to look upon them as essentially the same; the displacement in both cases being upwards and backwards, but in different instances partaking more of one or other direction. This dislocation may therefore be described as the *Ilio-sciatic*.

2. The next distinct dislocation is that in which the head of the bone is thrown *downwards* upon the obturator foramen, hence termed the *Thyroid* dislocation (Fig. 135).

3. The third variety is the *Pubic*, where the head of the bone is thrown *upwards* upon the pubic bone (Fig. 136); and lastly,

4. Various "anomalous" forms of dislocation may occur in different directions; as upwards, downwards, backwards, and forwards.

Thus it will be seen that, in whatever direction the displacement occurs, the head of the bone has a tendency to sink into some cavity or depression, or to lie upon one of the osseous surfaces in the neighbourhood of the acetabulum.

1. *Dislocation Upwards and Backwards, or Ilio-sciatic.* In this, if the head of the bone rest upon the *dorsum of the ilium*, the hip will be found to be a good deal distorted, the gluteal region being somewhat prominent, and the upper part of the thigh enlarged, in consequence of the approximation of the muscular attachments. The head of the bone can be felt in its new situation, more especially on rotating the limb; the trochanter is less prominent than natural, usually lying close against the brim of the acetabulum, and being turned forwards; there is considerable shortening, varying from one and a half to three inches, and the position of the limb is remarkable, being distinctly rotated inwards, with the thigh slightly bent upon the abdomen, and the leg upon the thigh, so that the knee is semi-flexed, and raised from the surface on which the patient is lying. The foot is inverted, so that the ball of the great toe rests on the ankle of the sound limb; and

the heel is somewhat raised. The axis of the thigh is directed towards the sound knee (Fig. 133). The movements of the joint are greatly impaired; abduction and eversion are not practicable; but inversion, abduction, and some flexion upon the abdomen, can be practised.

When the head of the bone slips a little further back so as to become lodged in the sciatic notch, we have the dislocation backwards of Sir A. Cooper. In this the same symptoms exist, though to a less degree; hence the diagnosis is proportionately difficult (Fig. 134). There is much less deformity about the hip in this variety of the displacement, owing to the head of the bone sinking into the hollow of the notch, and thus presenting the trochanter nearly in its usual position at right angles with the ilium, though somewhat behind and a little above its normal situation. In consequence of the head of the bone being received in a depression, the axis of the limb is not altered to the same extent as when it is thrown upon the plane surface of the dorsum ilii; hence the inversion of the knee and foot, though existing, is not so strongly marked. As the sciatic notch is but a little above the level of the acetabulum, the shortening of the limb is inconsiderable, not exceeding half an inch or an inch at most. The axis of the limb also is directed across the middle of the sound thigh, in consequence of the bone being thrown further backwards. Thus the signs of these two forms of dislocation are nearly identical in character, though varying in degree; the principal difference being that, when the head of the bone rests upon the dorsum ilii, the axis of the femur is directed to the opposite knee, whereas, when the head of the bone is lodged in the sciatic notch, the axis of the limb is directed across the middle of the sound thigh.

Causes—The dislocation upwards and backwards is that which is most frequently met with in the hip. It is occasioned by violence acting upon the limb whilst adducted, with the body bent forwards upon the thigh, or the thigh upon the abdomen; as when a person is struck on the back with a heavy weight, or is thrown forwards, or falls whilst carrying a heavy load upon his shoulders, when the upper and posterior part of the joint receives the whole of the strain. Under these circumstances, the capsular ligament is ruptured, and the bone slips out of its articulation.

The *Diagnosis* of this form of dislocation is easy in proportion as the head of the bone lies high on the dorsum ilii. The more it sinks towards and into the sciatic notch, the more difficult does the detection of the displacement become, and the greater the risk of its being overlooked altogether, or mistaken for a sprain. In ordinary cases of fracture of the neck of the thigh-bone, the existence of eversion of the limb at once points out that the head of the bone is not dislocated on the ilium. The only severe injury of the hip with which the dislocation upwards and backwards can be confounded, are those rare cases in which there is *fracture of the neck of the thigh-bone, with inversion of the limb*. In such instances, the increased mobility, and the existence of crepitus, will enable the surgeon to effect the diagnosis. Should, however, the fracture be an impacted extracapsular one, with inversion, then the difficulty of diagnosis is undoubtedly great. A correct conclusion may herein be arrived at, by observing that in the fracture the flattened trochanter is approximated to, and in nearly a perpendicular line with, the anterior superior spine of the ilium; whilst in the dislocation the trochanter is diagonally behind that process of bone, and the head of the thigh-bone can be felt in its new situation by deep manipulation of the gluteal region.

The *Reduction* of this form of dislocation is effected in the following manner. The patient, having been put under the influence of chloroform, is

laid on his back upon a strong table between two staples, one of which should be fixed to the floor and another at a point above the level of the body, in a direct line with the axis of the limb, and about twelve feet apart. The counter-extending force, consisting of a jack-towel or a padded leather belt, must then be passed between the injured thigh and the perineum, and fixed to the staple in the floor. The pulleys must now be attached to proper straps, or to a towel fixed with a clove-hitch knot immediately above the knee, by one end; the other extremity being attached to the staple in the wall, which should be so situated as to be continuous with the axis of the lower part of the limb. The knee being then slightly bent and rotated inwards, traction is applied slowly and steadily until the head of the bone has approached the acetabulum, when the surgeon rotates the limb inwards so that the head may slip into its socket (Fig. 137). If difficulty occur in

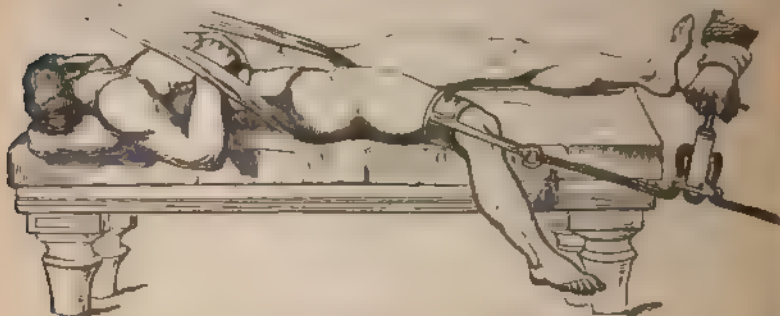


Fig. 137.—Reduction of Ilio-Sciatic Dislocation.

raising the bone over the acetabulum, recourse may be had to the plan recommended by Sir A. Cooper, of passing a towel under the thigh to enable an assistant to lift the head of the bone over the brim of the cavity. The fact of the reduction being accomplished is ascertained by comparing the bony points of the limb with those of the opposite side, and seeing if they correspond. A long splint and spica bandage should now be applied to fix the thigh, and the patient be kept in bed for a fortnight, so that reunion of the ruptured tissues may take place. In reducing this dislocation, there is some danger of the head of the bone slipping downwards into the sciatic notch, if the limb be too much raised. This accident, which has happened to some very excellent surgeons, may be mistaken for reduction of the bone; a serious mistake, which would, unless corrected, entail permanent lameness on the patient.

When the bone is thrown upon the sciatic notch, the reduction is difficult, and a slight modification of the treatment is required; this consists in laying the patient on his sound side instead of on his back, and making extension across the middle of the sound thigh instead of immediately above his knee, as in the last case. In the reduction of this dislocation also, Sir A. Cooper gives the very valuable advice, to lift the head of the bone out of the notch and over the edge of the acetabulum by means of a round towel placed under the upper part of the thigh and over the shoulders of an assistant, who, first stooping and at the same time resting his feet on the patient's pelvis, should then raise his head and draw the bone towards its socket.

Reduction of dislocation on to the dorsum ili or sciatic notch may be effected readily enough whilst the patient is under the influence of chloroform,

by "manipulation" of the limb, as introduced by Dr. Reed, of Rochester, U. S. This is done by flexing the leg on the thigh, and carrying the dislocated thigh over the sound one, flexing it slowly upwards, across the pelvis, as high as the umbilicus, and then abducting and rotating it outwards.

2. *Dislocation Downwards into the Obturator Foramen.* Here we find the hip flattened, and the prominence of the trochanter completely absent, or indeed replaced by a depression. The limb is lengthened by about two inches, advanced before the other, and considerably abducted (Fig. 135). The knee is bent and incapable of extension; the foot usually points forwards, but is sometimes slightly everted, and is widely separated from its fellow. The body is bent forwards in consequence of the tension of the psoas and iliac muscles, and in thin persons the bone may be felt in its new situation.

Cause.—This dislocation appears to be occasioned by the limb being suddenly and violently abducted, as by falls with the legs widely separated; in consequence of which the head of the bone is tilted against the inner side of the capsule, and, rupturing this, is thrown into the thyroid notch.

In the *Reduction* of this dislocation the patient should be placed upon his back; the counter-extending girth, or towel, is then placed round the pelvis, and fixed firmly to a staple next to the sound side of the patient. A padded girth is then to be placed between the perineum and the upper part of the dislocated thigh. From this, extension is made by means of the tourniquet or the pulleys, which are fixed to a staple at a little distance from the injured side of the patient. Extension having then been made to such a degree as to elevate the head of the bone from the depression in which it lies, the surgeon passes his hand behind the sound leg, and, seizing the ankle of the injured limb, draws it backwards and towards the mesial line, taking care to keep the knee straight, and thus throwing the head of the bone into the acetabulum by the action of a long lever (Fig. 138).

3. *Dislocation Upwards on the Pubic Bone* (Fig. 136). This presents very unequivocal signs. The hip is flattened; the head of the bone can be distinctly felt lying in its new situation above



Fig. 138.—Reduction of Dislocation into Obturator Foramen.

Bojart's ligament, to the outer side of the femoral vessels, where it may be made to roll by rotating the limb. The thigh and knee are slightly bent, rotated outwards, and abducted; the limb, which is separated from its fellow, is shortened to the extent of an inch.

The Cause of this dislocation is either direct violence applied to the back of the thigh whilst the limb is abducted; or it arises from the patient making a false step in walking, and, suddenly throwing his body backwards in order to avoid a fall, twisting and displacing the limb.

With regard to the Treatment, Sir Astley Cooper advises that the patient should lie upon his back with his legs widely separated; and that, counter-extension being then made by a girth carried between the perineum and the injured thigh, and fixed to a staple in front of and above the body, the pulleys should be fixed upon the lower part of the thigh, and the extension made downwards and backwards. After this has been continued for a suffi-



Fig. 139.—Reduction of Dislocation on the Pubic Bone.

cient time, an assistant lifts the head of the bone by means of a towel over the brim of the acetabulum (Fig. 139).

Other Forms of Dislocation.—The head of the thigh-bone may be dislocated in a variety of other directions.

a. It may be thrown *directly upwards*, so as to be situated under the anterior inferior spinous process, or between it and the anterior superior, with considerable shortening of the limb and the head of the bone to be felt in a new situation. In a case related by Cummins, the limb was shortened three inches.

β. The head of the bone may be thrown *directly downwards*, as happened in a case of Mr. Luke's, the head of the bone lying midway between the sciatic notch and the thyroid foramen, the gemellus inferior and the quadratus femoris having been torn.

γ. The head of the thigh-bone may be thrown *downwards and backwards*, lying upon the posterior part of the body of the ischium between the tuberosity and the spine. It can be felt in this situation, and the limb is inverted.

δ. The head of the bone may be thrown *downwards and backwards* into the lesser sciatic notch. In these cases there is considerable shortening, but the position of the limb appears to vary. In an instance that occurred to Mr. Keats, the limb was abducted and the toes turned outwards. In a case reported by Mr. Wormald the limb was turned inwards. Although the limb is described as shortened in these cases, Dr. Warren has related a case in which it was elongated.

ε. The head of the thigh bone may be thrown *forwards and inwards* into the perineum, so as to rest on the ramus of the pubic bone. In these cases the head of the bone can be felt in its abnormal situation behind the scrotum, and, compressing the urethra, has given rise to retention of urine. In one case the toes were turned inwards, in another outwards; the thigh usually projects forwards.

It is extremely difficult to lay down any distinct rules for the reduction of these various anomalous forms of dislocation. This will, however, usually be effected by extension by means of the pulleys in the direction of the axis of the bone, and by manipulation and rotation of its head towards the acetabulum.

Reduction of old Dislocations of the Hip-joint is attended not only with great difficulty, but with no small amount of danger. The probability of effecting reduction rapidly decreases with the length of time that the bone has been left unreduced, and this more in some dislocations than in others. It is it is easier to reduce an old dislocation on the dorsum *in* than one into the ischiatic notch. Dislocations of the head of the thigh-bone on the dorsum of the thigh may usually be reduced without any great increase of difficulty, up to the end of the first fortnight. After that time the difficulty increases considerably; and, although reduction has frequently been effected in these cases up to the sixth or eighth week, yet it has also not unfrequently failed, notwithstanding persevering and repeated attempts. After two months have elapsed, the reduction is not only a work of great uncertainty, but also of no slight danger from abscess, or fracture of the femur; and it is then seldom practicable. But cases have been reported, and are referred to at p. 290, in which these dislocations have been reduced at a much later period, even after six months.

If the bone be left permanently unreduced, it will in time acquire considerable mobility, more particularly if lying in the ischiatic notch, the patient walking readily with a shortened but otherwise useful limb.

The attempt to reduce old dislocations of the hip-joint is necessarily attended with danger. In some cases the soft parts have been extensively lacerated; in others fatal inflammation of the joint has ensued; and in at least eight cases with which I am acquainted, the thigh-bone has been fractured. This accident has happened to surgeons of such eminence as Travers, Vincent, Maigne, Physick of Philadelphia, to Gwynne of the Brighton Hospital, to Blackman of Cincinnati, to Harris and Randolph of the Pennsylvania Hospital, to the surgeons of the Northern Hospital in Liverpool, and to a practitioner in London now living. In most of these cases the bone gave way at its neck or below the trochanters; the dislocation was of course left unreduced, but the patients recovered without serious difficulty, the fractures being treated in the usual way. The cause of the fracture usually appears to have been the employment of force in a transverse or rotatory manner after extension had been kept up for some considerable time. But there is no proof that undue violence was used in any of these cases.

The Complication of Fracture of the Femur with Dislocation of the Hip-joint occasions a very serious state of things, that may baffle the most skilful efforts on the part of the surgeon to counteract. The line of practice to be adopted must depend in a great measure on the seat of fracture. If this be situated below the middle of the thigh, the limb should be put up tightly in temporary splints, and an attempt made under chloroform to reduce the dislocation in the ordinary way by pulleys applied over the splints, or by manipulation. If the fracture be high up, near or at the neck, the patient should be put under chloroform, and an attempt then made by pressure on the dislocated head and manipulation to replace it. It is possible that this might be effected, as in similar injuries of the humerus, with comparatively little trouble. Should reduction in this way not be practicable, we may adopt the plan successfully employed by Mr. Badley, who, in a lad of eighteen, with dislocation on the dorsum *in*, and fracture of the displaced bone, allowed union of the fracture to take place, and then at the end of *two weeks* effected reduction.

Simultaneous Dislocation of both hips, perhaps in different directions, or of one hip with fracture of the opposite thigh-bone, has been met with in some rare instances.

DISLOCATIONS OF THE PATELLA are not frequently met with. They may, however, occur in four directions, viz., *outwards*, *inwards*, *edgewise* or *vertically*, and *upwards*.

1. The dislocation *Outwards* is the most common variety of the accident; the bone being thrown upon the outer side of the external condyle of the femur, with its axis directed somewhat backwards and downwards. The knee is flattened in front, and is broader than usual; the patella can be felt in its new situation, and the muscles that form the quadriceps extensor are rendered tense, more especially the vastus internus; the leg is sometimes extended, but more frequently the knee is slightly flexed. This accident usually happens from sudden muscular contraction in persons who are knock-kneed. In some cases it has been occasioned by direct violence, driving the bone out of its position. Most frequently the dislocation is not quite complete, the patella being only partially displaced outwards, with some rotation of the bone in the same direction.

2. The dislocation *Inwards* is of very rare occurrence; Malgaigne, who has investigated this subject, being of opinion that there is only one case of the kind on record.

In these lateral dislocations, *Reduction* may be effected by laying the patient on his back, bending the thigh on the abdomen, and raising the leg so as to relax the extensor muscles. The surgeon then, by pressing down that edge of the patella which is furthest from the middle of the joint, raises the other edge, which, being tilted over the condyles, is immediately drawn into position by the action of the extensors.

3. A remarkable form of dislocation of the patella is that in which the bone becomes twisted upon its axis in such a way that it is placed *Vertically*, one of its edges being fixed between the condyles, and the other projecting under the skin, and pushing this forwards into a distinct tumour. In some cases, those of Dr. Woolf and Mr. Mayo, the bone has been turned almost completely round, the posterior surface becoming partly anterior. The signs of this dislocation are evident, manual examination indicating the vertical displacement of the patella, with a deep depression on each side. The limb is completely extended, flexion being impossible.

This peculiar dislocation is of very rare occurrence, there being not more than nine or ten cases on record. It has most generally arisen from sharp blows or severe falls upon one edge of the patella, whilst the limb has been semi-flexed, in consequence of which the bone appears to have been semirotated and fixed in its new position. Violent muscular contraction, however, conjoined with a twist of the leg, but without any blow, has been known to occasion it in some cases.

The *Reduction* of this displacement has sometimes been attended by the greatest difficulty; in other cases it has been readily effected; whilst in two or three instances it has been found to be quite impracticable; surgeons having ineffectually attempted by means of elevators and the section of the tendons or of the ligamentum patellæ, to replace the bone, and the patient having eventually died from traumatic suppuration of the joint, with the displacement unrelieved. The cause of this difficulty of reduction is not very distinctly made out; it is certainly much greater than can be explained by simple muscular contraction, and may not improbably be owing to the resistance offered by the aponeurotic structures which cover the bone becoming twisted or entangled under it, or, as Malgaigne supposes, by the superior

angle of the bone being wedged in the subcondyloid space. If relaxation of the muscles of the thigh, and the employment of proper pressure upon the patella, do not succeed, reduction may perhaps be effected by directing the patient to make a sudden and violent muscular effort at extension of the limb, or by attempting to walk. In other cases the bone has been readily replaced by bending the leg, and rotating it on the axis of the tibia, at the same time that the patella is pressed into position, as Vincent recommends. Upon the whole, forcible flexion of the knee appears to have answered better than any other method, and under chloroform will probably seldom be attended by difficulty. Should these plans not answer, I do not think it would be advisable to have recourse to subcutaneous section of the tendon of the quadriceps extensor and of the ligamentum patellæ. In one case in which both these structures were divided, the patella remained as firmly fixed as ever, and the patient eventually died of suppurative inflammation of the knee-joint; and in no case in which division has been practised does it appear to have facilitated the reduction of the bone.

4. Dislocation of the patella *Upwards* can only occur as a consequence of the rupture of its ligament. This accident, which is always accompanied by much inflammation of the joint, requires the same treatment as a fractured patella.

DISLOCATIONS OF THE KNEE.—This joint, owing to the breadth of its articular surfaces, and the great strength of its ligaments, is seldom dislocated. When such an accident happens, it usually arises from falls from a great height, or by the patient jumping from a carriage in motion. The tibia may be displaced in four directions: to either side, forwards, or backwards. Besides these displacements, the joint is subject to a partial luxation dependent upon displacement of the semilunar cartilages.

1. The *Lateral* dislocations of the tibia are the most common. They are always *incomplete*, and are usually accompanied by a certain degree of rotation of the limb in an outward direction. These displacements may either be *external* or *internal*. In the first, the outer condyle of the femur rests upon the inner articular surface of the tibia. In the other, the inner condyle is placed upon the outer articular surface of the head of this bone. In either case, the knee is slightly flexed; there is a marked sulcus in the situation of the ligamentum patellæ; the extensor muscles of the thigh are relaxed, and the deformity of the joint indicates at once the nature of the displacement to which the bones are subject.

In these cases *Reduction* is always easy; indeed, occasionally it is effected by the unaided efforts of the patient or by a bystander. It may be accomplished by flexing the thigh upon the abdomen, then extending the leg, and, at the same time, by a movement of rotation, replacing the bones in their proper position.

2. The dislocation *Backwards* may be *complete* or *incomplete*. When it is complete, the posterior ligament of the joint is torn, the muscles of the ham are stretched, the limb is shortened to the extent of an inch and a half or two inches, and is semiflexed; the head of the tibia can be felt in the ham, and there is a deep transverse depression in front of the joint immediately below the patella.

3. The dislocation of the tibia *Forwards* is of more frequent occurrence than the last accident. In it, the lower end of the femur is felt projecting into the ham, compressing the vessels to such an extent occasionally as to arrest the circulation through the lower extremity, lacerating the ligaments, and stretching the muscles in this situation. The tibia is felt to project forwards, its head forming a considerable prominence on the anterior part of

the knee, with a deep depression immediately above it and the patella, which is rendered more evident by the relaxation of the extensors of the thigh, the leg is usually rotated somewhat inwards or outwards, and there is shortening to the extent of about two inches.

These antero-posterior dislocations are very commonly incomplete. When this is the case, they present the same symptoms, but in a less marked degree, that characterise the complete displacements.

In the *Treatment* of these dislocations, extension should be made from the ankle whilst the thigh is fixed in a semiflexed position. When the leg has been drawn down sufficiently, proper manipulation will bring the bones into accurate position; splints must then be applied, means taken to subdue local inflammation, and the joint kept perfectly at rest for two or three weeks, at the end of which time passive motion may be commenced.

Subluxation of the Knee, or "internal derangement of the knee-joint," is an accident of more frequent occurrence than any of those that have just been described. It usually occurs from the patient, whilst walking, striking his toe against or tripping upon a stone, when he is suddenly seized with acute and sickening pain in the knee, often so severe as to cause him to fall to the ground. Before doing so, however, he is conscious of having strained or otherwise injured the joint. On examination it will be found semiflexed, the patient being unable to extend the limb properly, and every effort being attended by severe pain. In the course of a very short time the joint becomes swollen, being distended by synovial secretion; and symptoms of subacute synovitis are speedily superadded to the original injury.

This accident, originally described by Hey, and since investigated by Sir A. Cooper and others, occurs in consequence of the semilunar fibro-cartilage slipping away from under the internal condyle, either before or behind it, so as to bring the surface of the condyle and that of the tibia into direct apposition. The severe pain that is always experienced is owing, in all probability, to the nipping of the loose folds of synovial membrane that lie within the joint—the so called mucous and alar ligaments, and also to the great stretching of the ligaments by the partial displacement of the bones.

The *Reduction* may be effected by flexing the joint, and then, when the muscles are off their guard, the patient's attention being directed elsewhere, rapidly extending it at the same time that a movement of rotation is communicated to the leg. The evidence of complete reduction consists in the power of extending the articulation being regained by the patient. The synovitis that usually follows this injury requires to be treated by local antiphlogistics and rest. After it has been subdued, the patient should wear a laced knee-cap, as the joint will be weakened and liable to a recurrence of the same injury.

Complications.—Dislocations of the knee-joint are more liable to serious complications than those of any other articulation. Not only are the ligaments torn, and the muscles injured, but stretching, and perhaps laceration, of the popliteal vessels, followed by gangrene of the limb, may occur; or the joint may fall into a state of suppurative and destructive inflammation, as the result of the injury.

Compound Dislocation of the Knee-joint constitutes one of the most serious injuries to which the limbs are liable; the external wound being usually large, ragged, and accompanied by the protrusion of the condyles of the femur, with much laceration of the soft structures in the vicinity of the joint. These are cases that certainly, as a general rule, call imperatively for

amputation ; indeed, Sir A. Cooper regards this injury as one especially demanding removal of the limb. Cases, however, have occurred in which the limb, even under these circumstances, has been saved. Hence, if the patient be young, and if the vessels of the ham do not appear to have been seriously injured, the wound in the soft parts at the same time not being very extensive, or much bruised, an attempt may with propriety be made to save the joint. In a case of compound dislocation of the knee forwards in a boy, the late Mr. A. White sawed off the projecting end of the femur which protruded through the ham, and, bringing the wound together, succeeded in saving the limb.

The *Head of the Fibula* has occasionally, though very rarely, been displaced by the application of direct violence to it. Boyer and Sauason have each recorded a case of this kind.

DISLOCATIONS OF THE ANKLE occur in consequence of displacement of the astragalus from the bones of the leg, whilst it continues to preserve its normal connection with the rest of the foot. These dislocations are almost invariably connected with fracture of the lower end of the fibula, or of the inner malleolus. In fact, in looking at the arched cavity into which the astragalus is received, it is evident that this bone can scarcely be displaced laterally without fracture of one side of this arch. In considering these dislocations we must, in accordance with the general nomenclature of similar accidents, in which the distal part is always said to be displaced from the proximal, look upon the foot as being dislocated from the leg, and not consider the tibia as being displaced upon the foot. The direction of the dislocation must consequently be determined by the position into which the articular surface of the astragalus happens to be thrown. It is necessary to explain this, inasmuch as a good deal of ambiguity occurs in surgical writings from the same accident being described differently, according to the view taken of the part displaced. Thus, Sir A. Cooper speaks of the tibia as being dislocated at the ankle ; whilst Boyer and others, regarding the foot as the part displaced, have described the same injury in directly opposite terms.

Dislocations of the foot from the bones of the leg may take place in four directions, viz., *laterally, to either side ; backwards ; or forwards*. In all cases, the injury appears to be occasioned either by the foot being twisted under the patient in jumping or running ; or else by its being suddenly arrested by coming into contact with the ground whilst the body is carried forwards. But, as has already been stated at p. 210, those twists do not necessarily occasion dislocation, and must not be confounded with that accident.

The dislocation *Outwards* is of most frequent occurrence. In it the inner malleolus projects forcibly against the skin ; there is a depression above the outer ankle corresponding to a fracture of the fibula ; and the sole of the foot is turned upwards and outwards, the inner side touching the ground, whilst the outer edge is turned up.

In the dislocation *Inwards*, which is a rare accident, and, according to Sir A. Cooper, a much more dangerous one than that just described, the fibula is not fractured, but the lower end of the tibia is splintered off, in an oblique manner from within outwards. The outer edge of the sole rests against the ground, and the inner side is turned up.

The *Reduction* of these lateral displacements is readily effected by simple traction into proper position, leg splints with lateral foot-pieces must then be put on, or Dupuytren's splint may be applied on the same side as the dislocation, opposite to that on which the eversion of the foot takes place.

In the dislocation of the foot *Backwards*, the deltoid ligament is ruptured, the fibula broken in the usual situation, and the tibia thrown forwards on the navicular and internal cuneiform bones; the foot is consequently shortened, and the heel rendered more projecting.

The dislocation *Forwards*, in which the foot is lengthened, and the tibia thrown upon the upper and posterior surface of the os calcis, behind the astragalus, is an accident so rare as seldom to have been witnessed, although described.

In the *Treatment* of these antero-posterior displacements of the ankle, traction of the foot in a proper direction, the leg being fixed and flexed upon the thigh, will readily be attended by replacement of the bones, the application of lateral splints being afterwards sufficient to keep the parts in proper position.

Compound Dislocations of the Ankle-joint are serious and by no means unfrequent accidents, the displacement occurring in the same direction as from the same causes as the simple forms of injury.

The *Treatment* of compound dislocations of the ankle-joint must depend to a considerable extent upon the amount of laceration of the soft parts, and the condition of the bones forming the arch of the joint. If the wound in the soft parts be inconsiderable in extent, clean cut, and with little injury to the bones, the limb should be placed on a M'Intyre's splint; and the lips of the wound, being well cleaned, brought together by strapping, or covered by lint soaked in collodion; evaporating lotions may then be applied, the constitutional condition of the patient carefully attended to, and the case treated in much the same way as a compound fracture. In many instances this plan will suffice, and the patient will recover with a still but useful limb, the joint being only partially ankylosed.

If, however, the bones be projecting and comminuted, and the wound more extensively lacerated, the question of amputation will necessarily arise. In many cases, the operation may be dispensed with by adopting the treatment recommended by Hey, of sawing off the malleoli, removing splinters of bone, cleaning the wound, bringing together its edges by simple dressing, and supporting the limb at the same time upon a M'Intyre's splint. If the joint be still more seriously injured, the posterior tibial artery torn, or the foot greatly contused, or if the patient's constitution be shattered and irritable, primary amputation should be had recourse to. I believe, however, that the disinclination on the part of surgeons to amputate in these cases, owing to the strong expression of opinion by Sir A. Cooper in favour of the attempt to save the limb, has in many cases been carried to such an extent as seriously to endanger the patient's life. Secondary amputation may be rendered necessary in consequence of gangrene, erysipelas, or extensive suppuration.

DISLOCATIONS OF THE ASTRAGALUS.—The astragalus is occasionally displaced from its connection with the bones of the leg above, and with those of the tarsus below, being thrown either *forwards* or *backwards*, the displacement forwards happening far more frequently than that in the opposite direction. In the dislocation *forwards*, the head of the bone may be thrown either *outwards* or *inwards*; but I do not think there is any evidence to show that complete lateral dislocation of this bone can occur irrespective of displacement forwards; the so-called *lateral* dislocations being displacements of the bone forwards, with twists to one or the other side. The dislocations *forwards* with lateral inclination may either be *complete* or *incomplete*. When it is *complete*, the bone is thrown out of its bed on the calcaneum, and separated from its connections with the malleolar arch above and the

scaphoid in front, being forced in front of the tarsus, and lying upon the scaphoid and cuneiform bones. When the dislocation is *incomplete*, the head is separated from the scaphoid, and is thrown up on the external cuneiform or cuboid bones, the body of the astragalus maintaining its connexions with the malleolar arch and os calcis. The dislocation *backwards* is, I believe, always *complete*. In the luxation backwards there is no rotation of the bone, which is thrown directly behind the tibia, in the space between it and the tendo Achillis.

These dislocations invariably happen from falls upon or twists of the foot; more particularly when it is in a state of extension upon the leg. When the foot is in this position, the lower end of the tibia either breaks off on the application of sufficient violence, or the head of the astragalus is forced out of the cavity of the scaphoid and its bed on the os calcis; the particular kind of displacement that occurs depending upon the direction in which the force is acting and in which the foot is twisted. And, as the foot is more frequently twisted inwards, the head of the astragalus is thrown outwards. Dislocation of the astragalus differs from dislocation of the foot in this—that when the foot is dislocated, the astragalus, though thrown out from under the malleolar arch, preserves its connections with the rest of the tarsus, whilst these are always broken through when the astragalus is the bone dislocated, even though it have not completely escaped from between the malleoli.

The dislocation of the astragalus *Forwards*, with twist of the bone *inwards*, is said to be of most common occurrence: I have, however, more frequently witnessed that form of accident in which the bone is thrown somewhat outwards as well as forwards. In either case the displaced bone forms a distinct tumour upon the instep, in the outline of which the form of the astragalus can be distinctly made out. Over this, the skin is so tightly drawn as often to appear to be on the point of bursting. When the bone is thrown somewhat inwards the foot is turned outwards, and the internal malleolus projects distinctly. When the astragalus is thrown outwards, displacement of the foot in an inward direction, with great projection of the lower end of the fibula, takes place. In some cases, fracture of the neck of the astragalus is conjoined with these dislocations; and not uncommonly the luxation is compound from the very first, or speedily becomes so if left unredressed, in consequence of the sloughing of the skin which covers the anterior surface of the bones, the exposed portion of which undergoes necrosis, and perhaps eventual exfoliation.

The dislocation *Backwards*, into the hollow under the tendo Achillis, is of *rare* occurrence, there being but seven recorded instances of this accident. In the majority of these there was displacement of the bone *inwards*, as well as backwards. In these cases the diagnosis is easy, as the bone forms a distinct prominence, which can be felt under the tendo Achillis.

In many cases the dislocation of the astragalus is not altogether complete, the under surface of the tibia not coming into direct contact with the upper surface of the os calcis; a portion of the astragalus still intervening between these bones.

Treatment.—The reduction of the dislocation *forwards*, whether attended by lateral displacement or not, varies greatly in the facility of its execution, in some instances being effected with the greatest possible ease, in others being attended by almost unsurmountable difficulties. This difference in the facility of reduction depends, I think, on whether the dislocation is *complete* or not. When the astragalus is not completely thrown from under the arch formed by the bones of the leg, a portion of it being still

entangled between their articular surfaces and that of the calcaneum, it may usually be readily reduced by relaxing the muscles of the calf, and pushing the bone back into its proper position. But when the astragalus is completely dislocated, the upper surface of the calcaneum is drawn up under the arch of the malleoli by all the strength of the muscles that pass from the leg to be inserted into the foot. Under these circumstances, in order that reduction take place, it is necessary first of all to separate the articular surfaces to such an extent as to admit of the astragalus being pushed back into its socket; this is almost impossible, owing to the great perpendicular thickness of this bone, to the extent to which it is consequently necessary to draw down the foot, and to the little purchase that can be obtained on it. In such cases as these, reduction has been greatly facilitated by the division of the tendo Achillis, by which simple operation the whole strain of the muscles of the calf is taken off.

If reduction be still impracticable, and the bone continue to be unreduced and irreducible on the dorsum of the foot—what should then be done? Two courses present themselves to the surgeon; either at once to cut down upon the astragalus and to remove it from its new position; or to adopt a palliative treatment—to put the limb at rest on a splint, to apply evaporating lotions, and to wait the result, acting according to circumstances as they develop themselves. In some rare cases the displaced astragalus has given rise to comparatively little inconvenience; but this can seldom be expected. If the dislocation have been in the direction forwards, the skin will usually slough, and then a portion of the exposed osseous surface, which will probably necrose, may be excised, or the whole of the astragalus may be dissected out by freely exposing it and severing its ligamentous attachments; the patient recovering with a somewhat stiffened, but still useful joint. This plan appears to be safer than excising the bone in the first instance, so soon as the dislocation has been found to be irreducible.

In luxation *backwards*, the bone has not hitherto to my knowledge been reduced, except in one case which occurred in University College Hospital, and in which the tibia and fibula were also fractured. It is by no means improbable that subcutaneous division of the tendo Achillis may in future enable the surgeon to effect reduction. The result is, however, satisfactory, even though the bone be not reduced, the patient recovering with a useful foot. If the dislocation be left unreduced, the soft parts covering the bone may slough, as happened in a case recorded by Dr. Williams of Dublin, in which the bone was consequently extracted.

In *Compound Dislocation of the Astragalus* (Fig. 140), the rule of practice

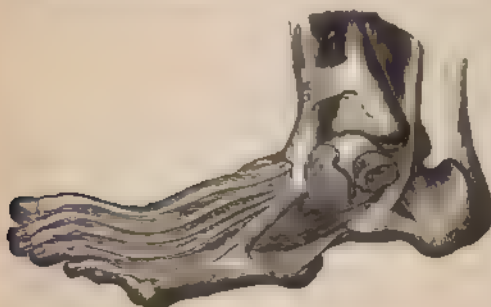


Fig. 140.—Compound Dislocation of Astragalus

must depend upon the extent of injury. If the integuments have merely been rent in consequence of the tension to which they have been subjected by the outward pressure of the displaced bone, an attempt must be made to reduce the dislocation, aided if necessary by the division of the tendo Achillis; and, if this be effectual,

to close the wound by the first intention. If the bone be comminuted as

well as dislocated, the proper practice will be to remove the loosened fragments, and to dress the wound in the simplest manner, allowing it to heal by granulation. If the bone be irreducible, it is a question whether it should be left or dissected out. If it be left, the wound in the integuments will certainly extend by a sloughing process, the bone will inflame and become carious or necrosed, exfoliating in fragments, and the patient will only recover after a prolonged, tedious, and dangerous course of treatment. Under these circumstances, therefore, it appears to me that the simpler and safer plan both to limb and life consists in enlarging the wound in proper directions, so as to dissect out the irreducible astragalus, and then bringing the articulating surfaces into contact, dressing the parts lightly, and trusting to the formation of a new joint between the tibia and the os calcis. So, also, if a simple dislocation of the astragalus become compound in consequence of the sloughing of the superjacent tense integuments, the exposed and necrosing bone should be removed in part or in whole, according to the circumstances of the case. If, together with the dislocation of the astragalus, the foot be extensively crushed, amputation may be required either at the ankle-joint or at some convenient part of the leg.

DISLOCATION OF THE OTHER TARSAL BONES is of extremely rare occurrence. Most of them, however, have been found to have been luxated at times.

The *Calcaneum* and *Scaphoid*, carrying with them the rest of the foot, are sometimes dislocated from the astragalus, which is left *in situ* under the malleolar arch. In these dislocations the bone may be displaced in either lateral direction—outwards or inwards. The *Treatment* consists in the flexion of the leg and attempts at reduction by extension of the foot in the ordinary way. If moderate extension fail in effecting reduction, M. Palsel has recommended the division of the tendo Achillis, and, if necessary, of the posterior tibial tendon, as a means of facilitating this, on the same principle in which it has been done in dislocation of the astragalus itself.

The *Calcaneum* has been dislocated laterally from its connection with the cuboid in consequence of falls from a height, the sufferer alighting upon his heel. Celsus mentions a case in which this bone was dislocated by the effort of drawing off a tight boot. *Reduction* seems to be readily effected by relaxing the muscles, and pressing the bone back into its proper position.

The *Scaphoid* and *Cuboid* Bones have been found to be dislocated upwards, in consequence of a person jumping from a height and alighting upon the ball of the foot. In these instances the limb is shortened and curiously distorted, the toes pointing downwards, and the arch of the instep being increased so as to resemble closely enough the deformity of club-foot. *Reduction* may be effected by drawing and pressing the parts into position.

The *Great Cuneiform Bone* has occasionally been found to be dislocated. Dr A. Cooper mentions an instance of this kind. If reduction be not effected by pressing the bone into its position, no great evil appears to result to the patient, the motions of the limb not being seriously interfered with.

DISLOCATION OF THE METATARSAL BONES, though excessively rare, from the manner in which they are locked in between the bones of the tarsus, and retained by short and strong ligaments, yet occasionally occurs; instances being recorded by Dupuytren and Smith. Liston also mentions a case of luxation of the metatarsal bone of the great toe from direct violence. Tufnell records a case of luxation downwards and backwards of the inner three meta-

tarsal bones, from a fall upon the leg by a horse rolling on its rider; and a case has occurred in my practice, in which by the pressure of a "turn-table" on a railway, the *outer* three metatarsal bones were dislocated downwards.

Luxations of the *Phalanges of the Toes* but rarely happen, and present nothing special in nature or treatment.

INJURIES OF REGIONS.

CHAPTER XXII.

INJURIES OF THE HEAD.

THE consideration of injuries of the head is one of the most important studies that can engage the surgeon's attention. The importance attached to it is not so much due to the special considerations connected with the mere injury of the scalp and skull, as to the effects that are produced as the result of the implication of the brain and its membranes, in many cases directly, and in others indirectly and remotely, owing to the anatomical connections and consequent close pathological sympathies that subsist between the external and internal structures of the head. In consequence of this tendency to cerebral complication, it is of the first moment in practice to study these injuries as a whole, and with special regard to the affections of the encephalon produced by them, and from which the injury of the scalp and the fracture of the skull derive the greater part of their importance. It is therefore necessary, in the first instance, to be acquainted with the nature and treatment of the principal forms of cerebral affection that supervene upon these accidents, before we proceed to study the special nature and peculiar modifications of treatment required by the conditions that occasion them.

CEREBRAL DISTURBANCE.

There are three principal *primary* states of functional disturbance arising from injury to which the brain is subject, viz., 1. Concussion, 2. Compression, and 3. Cerebral Irritation. Any one of these may be followed by, or be complicated with, inflammatory actions of various kinds, that derive much of their peculiar characteristics from the conditions with which they are associated, and from the injuries by which they are occasioned.

In describing these different conditions, we are compelled to define more distinctly the symptoms that characterise them, than is the case in actual practice, where they are not so closely individualised, but become merged together to a considerable extent.

1. **CONCUSSION OF THE BRAIN.**—Concussion, or stunning, appears to be a shock communicated to the nervous system from the application of such external violence as will produce commotion of the substance of the brain, or interfere with the circulation through it; in consequence of which its functions become temporarily suspended, usually in a slight and transitory degree, but occasionally to such an extent that the patient does not rouse for many hours from the depressed state into which he is thrown, and perhaps sinks without recovery. In those cases in which death immediately results from the continuance and severity of the concussion, the patholo-

great conditions vary much; either no lesion at all may be found in the cerebral substance, or it may have been rendered so soft and semi-diffuse by the shock to which it has been subjected, as to be evidently incompatible with life, even though no distinct rupture of its substance appear to have taken place. In other cases, again, more serious injury, such as rupture of it, may have occurred.

The *Signs* of concussion vary according to the severity of the injury to the brain. In the slighter cases, the patient may merely feel giddy and confused for a few minutes. In others, again, consciousness is not affected, but he feels faint and weak, being unable to stand. In the more severe forms—in that degree, indeed, which usually accompanies any severe injury of the head—the surface becomes cold and pale; the sufferer is motionless and insensible, or only answers when spoken to in a loud voice, relapsing again into speedy insensibility, or rather semi-consciousness; the pulse is feeble, the pupils are contracted, and the sphincters usually relaxed; the limbs are flaccid, and muscular power is lost. After this condition, which is the first stage of concussion, has lasted for a few minutes or hours, according to the severity of the shock, the second stage comes on; the circulation gradually re-establishing itself, the pulse becoming fuller, and the surface warmer. About this time the patient very commonly vomits; the straining accompanying this effort appears to be of service in stimulating the heart's action, and driving the blood with more vigour to the paralysed brain, thus tending to restore its functions; and we accordingly find that, after vomiting has occurred, the sufferer quickly rallies. In the more severe cases, the symptoms that have just been described are so strongly marked that the patient appears to be moribund; there is complete prostration of all nervous and physical power; the surface being cold and death-like, the eyes glassy, the pupils either contracted or widely dilated, the pulse scarcely perceptible and intermittent. In this state the patient may lie for hours, recovery being slow, and the concussion merging into some other and perhaps more serious affection of the nervous centres; or, indeed, in some cases, speedily terminating in death, apparently by failure of the heart's action.

The *Terminations* of concussion are various. We have already seen that in some cases this affection may speedily give way to complete recovery; although slight headache, some degree of giddiness, confusion of thought, and inaptitude for mental occupation, may last for a few days before the mental powers are completely re-established. In other cases, again, the concussion may rapidly terminate in the patient's death; but between these conditions there are several intermediate states. Thus, the recovery may be complete, but a permanently irritable state of brain may be left; the patient, though capable of the ordinary duties of life, becoming readily excited by slight excesses in diet or in the use of stimulants, or by mental emotion, though not of an inordinate intensity. Individuals thus affected, suffering from a preternaturally irritable brain, frequently die suddenly in the course of a few months, or a year or two after the receipt of the injury.

In other cases the recovery continues to be incomplete; although the patient may be enabled to follow his usual occupation, and to mix in the ordinary business of life, yet his state is a precarious one, the brain being liable to the occurrence of inflammatory disease on the slightest exciting cause. In such cases as these, there is frequently a certain degree of impairment of mental power, the memory failing either generally or in certain important points, as with reference to dates, persons, places, or language. The speech is perhaps indistinct and stuttering. Amaurosis of one or both eyes, with

perhaps squinting or paralysis of the eyelid, may be left. The hearing may be impaired, or noises of various kinds set up in the ears. There may be diminution or loss of muscular and of vital power, especially, as Hennen observes, in those cases in which the injury has been inflicted upon the back of the head; and Holberton has noticed that, when the medulla oblongata has been injured, the pulse may continue preternaturally slow—an observation which I have had several opportunities of confirming in injuries both of the medulla, the pons, and the crura cerebri. For these symptoms to occur, it is by no means necessary that the original local injury should have been a severe one. In some cases, in railway accidents more especially, or in falls from a height, the whole nervous system appears to be jarred and concussion without any wound or apparent sign of external injury of the head. At first, the symptoms of concussion are but slight, perhaps even none are apparent, and the sufferer congratulates himself on his escape; but gradual impairment of nervous power, manifesting itself in one or other of the ways just mentioned, comes on, and the health continues broken through life.

In other cases, again, the symptoms of concussion may gradually terminate in those of compression; and not unfrequently the reaction that comes on, passing beyond the bounds that are necessary for the re-establishment of the healthy functions of the brain, terminates in an inflammatory condition of this organ. Liston has truly observed, that no injury of the head is too trivial to be despised, or too serious to be despaired of.

2. COMPRESSION OF THE BRAIN.—This is a common condition in injuries of the head, arising as it does from a great variety of causes:—from the pressure of a portion of bone, of blood extravasated, or of pus formed within the skull, or from a foreign body lodged there. In whatever way occasioned, however, the symptoms, although presenting some differences, are tolerably constant. The patient lies in a state of coma, stupor or lethargy, being paralysed more or less completely, heavy, insensible, and drowsy, not answering when spoken to, or only when addressed in a loud voice, and perhaps shaken at the same time. The breathing is carried on slowly and deeply, with a stertorous or snoring noise, and usually a peculiar blowing of the lips. The stertor appears to be owing to paralysis of the *velum pendulum palati*, which, hanging down as an inanimate curtain, is thrown into vibrations during expiration by the passage of the air across it; the distension of the cheeks and blowing of the lips are due to the loss of tonicity in these structures. One or both pupils are dilated; the pulse is full, often slow; the feces pass involuntarily, from paralysis of the sphincter ani, and the urine is not uncommonly retained, from paralysis of the bladder; the skin may be cool, but in many cases, on the contrary, is rather hot and perhaps perspiring. Not unfrequently this state of stupor alternates with paroxysms of delirium, or of local convulsive action.

This state of coma may become complicated by the occurrence of symptoms of inflammation: and, unless the cause that produces the compression be removed, it usually terminates speedily in death, the patient gradually sinking into more complete unconsciousness, and dying in an apoplectic condition. In other, but much rarer cases, the coma may continue almost an indefinite time, for many weeks or even months, until the compressing cause is removed, when the patient may recover consciousness, and the symptoms suddenly disappear.

The *Diagnosis* between *concussion* and *coma* has been sufficiently indicated in the preceding description of these two conditions not to require special mention here. But it must be remembered that, in many cases, one state merges into the other, so that the symptoms are not so distinctly marked as

has been indicated, and they are more especially obscured when associated with inflammatory action.

3. CEREBRAL IRRITATION.—The third form of primary cerebral disturbance which is met with in injuries of the head, differs very remarkably from both the preceding. In it the patient presents symptoms neither of concussion nor of compression, nor is there any combination of the phenomena characterizing these two states; but the symptoms are altogether peculiar. For convenience of description, they may be divided into two groups, the *bodily* and the *mental*.

The *bodily symptoms* are as follow. The attitude of the patient is peculiar and most characteristic;—he lies on the side, and is curled up in a state of general flexion. The body is bent forwards, the knees are drawn up on the abdomen, the legs bent, the arms flexed, and the hands drawn in. He does not lie motionless, but is restless, and often, when irritated, tosses himself about. But, however restless he may be, he never stretches himself out nor assumes the supine position, but invariably reverts to the attitude of flexion. The eyelids are firmly closed, and he resists violently every effort made to open them; if this be effected, the pupils will be found to be contracted. The surface is pale and cool, or even cold. There is no heat of head. The pulse is small, feeble and slow, seldom above 70. The sphincters are not usually affected, and the patient will pass urine when the bladder requires to be emptied; there may, however, though rarely, be retention.

The *mental state* is equally peculiar. Irritability of mind is the prevailing characteristic. The patient is unconscious, takes no heed of what passes, unless called to in a loud tone of voice, when he shows signs of irritability of temper, or frowns, turns away hastily, mutters indistinctly, and grinds his teeth. It appears as if the temper, as much as or more than the intellect, were affected in this condition. He sleeps without stirrer.

The course taken by these symptoms is as follows. After a period varying from one week to three, the pulse improves in tone, the temperature of the body increases, the tendency to flexion subsides, and the patient lies stretched out. The mental state also changes. Irritability gives way to fatuity; there is less manifestation of temper, but more weakness of mind. Recovery is slow, but, though delayed, may at length be perfect; although in these, as in all other cases of cerebral disturbance, ulterior consequences may be manifested.

This form of cerebral disturbance may, from the peculiar irritability that characterises it, be with propriety termed *cerebral irritation*.

The symptoms that have just been described usually follow blows upon the temple or forehead, and probably in many cases may arise from, or are associated with, lacerations of the cerebral substance, more especially of the grey matter.

The *secondary consequences* of injury to the brain consist of, 1, Inflammation, and 2, the Deposit of Pus and other inflammatory exudations upon or within that organ and its membranes.

1. TRAUMATIC ENCEPHALITIS.—Inflammation of the brain and its membranes from injury (*Traumatic Encephalitis*), is an affection of great frequency and corresponding importance. It is a condition that is specially apt to supervene on all injuries of the head; though the liability to it necessarily increases with the severity of the accident. This form of inflammation of the brain and its membranes may set in with great intensity in some cases, the symptoms of phrenitis being strongly marked; in other instances, it gradually creeps on in a slow and insidious manner, not attracting

accompanied by the two local signs just mentioned, has afforded proof of the existence of pus within the skull. It but seldom happens, however, that the signs attending the formation of pus within the skull occur in the distinct order and with the degree of precision above stated. In the great majority of cases, the surgeon can only suspect the presence of pus by the symptoms of inflammation terminating in paralysis or coma. But he cannot say with certainty that pus has formed, for the coma may arise from the pressure of other inflammatory effusions : but if the puffy swelling of the scalp or the separation of the pericranium occur, with exposure of dry and yellow bone, with hemiplegia on the opposite side, then he may feel himself justified in giving a more positive opinion as to its existence in some situation within the cranial cavity, probably beneath or in the immediate neighbourhood of the part thus affected.

Pyæmia, with its characteristic visceral secondary abscesses, is by no means an unfrequent complication of injuries of the head. It may occur as a consequence of any lesion of the scalp, skull, or brain, in which the patient survives sufficiently long for the development of the characteristic phenomena of this disease. As this is of necessity chiefly the case in the slighter forms of cerebral injury, it is after these that purulent infection and secondary abscesses have principally been met with ; occasionally after wounds of the scalp, rarely after those of the brain or its membranes, but more commonly and not unfrequently after injury of the skull, more especially after severe contusions of the bone without fracture.

The sequence of pathological phenomena in these cases is the same that is observed in all in which pyæmia follows injury or wound of the osseous structures. The part of the bone that is struck usually necroses, inflammation and suppuration are set up in the surrounding portions of the skull ; the cells of the diploe, cancellated in structure, become filled with pus ; its veins, which are large and sinuous, inflame, and become the media of transmitting pus to the general circulation, the ordinary constitutional symptoms of pyæmia develop themselves, and secondary abscesses eventually form in the lungs, liver, and joints, with lowly organised plastic effusions into the serous cavities, more particularly those of the pleura and pericardium. The older writers on Surgery had noted and had marvelled at the strange phenomenon of hepatic abscess following slight head-injuries, and had generally overlooked the occurrence of secondary deposits in other organs and structures. More modern investigation has shown that these abscesses are pyæmic, that they are a part of a general purulent infection of the system, and that they almost invariably are accompanied by pulmonary abscesses : indeed, it is these and not the hepatic that are the common consequences of pyæmia resulting from cerebral injury. Of eighteen cases, Mr P. Hewett found the lungs studded with abscesses in thirteen, and the liver in three ; and of these three, in one case only was the liver alone affected. It has been supposed by some that intracranial suppuration is a necessary precursor of these secondary abscesses : that it frequently co-exists is undoubted—we often meet with pus in these cases between the dura mater and the contused bone ; but to suppose that it is a necessary concomitant, is an error. I have seen cases in which the most extensive secondary deposits were found in the lungs, liver, joints, &c., but in which not a drop of pus existed in the interior of the skull in any part ; but I have never seen a case in which the diploe around the injured bone did not contain pus, sometimes diffused through its cells, at others filling its venous sinuses.

When intracranial suppuration co-exists with secondary pyæmic deposits, the symptoms of the two conditions become so mixed up as to lead to con-

considerable difficulty in establishing a certain diagnosis; but when the intracranial suppuration is not developed, there may be a complete absence of all cerebral disturbance, whilst the alternating rigors and heat of pyæmia, the oppressed breathing, or the hepatic tenderness, with hiccup or recurring sickness, and the articular tenderness, give unmistakable evidence of the formation of secondary abscesses.

The prognosis of these cases is necessarily in the highest degree unfavourable. I doubt much whether recovery is possible when once pyæmia, consequent on head injury, has advanced to the formation of secondary visceral abscesses.

TREATMENT.—The treatment of these various cerebral injuries, and their concomitant affections, is one of the most important and difficult subjects that can arrest the surgeon's attention; the difficulty depending in a great measure on the various conditions that have just been described not occurring in practice with that amount of distinctness and individuality by which their characters can alone be conveyed in description, but being associated together in such a way that the exact state of the patient cannot so readily be made out. There are few cases, indeed, in which practical tact and a nice discrimination and analysis of symptoms are more required than in those now under consideration. It would, however, be useless to attempt to describe the shades and modifications of treatment required in the management of the different groupings of these various forms of traumatic cerebral disturbance. We must, therefore, content ourselves with describing the treatment of each state broadly and separately, and leave the consideration of the varieties that so commonly present themselves in practice to the individual tact of the surgeon.

In the *Treatment of Concussion*, the first great indication is to re-establish the depressed energies of the circulation and of the nervous system. In effecting this, we must, however, be careful not to overstimulate the patient. The safest practice is that which is applicable to the treatment of shock generally,—to wrap the patient up warmly in blankets, to put hot bottles around him, to employ frictions to the surface, and, when he is sufficiently recovered, to allow him to swallow a small quantity of warm tea. Alcoholic stimulants of all kinds should be avoided, as their effects may be injurious, unless the depression of the nervous energy be so great that reaction cannot be brought about without their agency. But an enema containing some ether or aromatic spirits of ammonia may be exhibited.

When reaction has come on, steps should be taken to prevent the occurrence of inflammatory mischief. With this view, if the concussion have been slight, it may be quite sufficient to purge the patient well, and to keep him quiet on a regulated diet for a few days, directing him carefully to avoid all alcoholic stimulants and mental exertion for some time. If the concussion have been more severe, and if the symptoms of reaction have been accompanied by indications of continuous cerebral disturbance, or have been followed by giddiness, headache, or confusion of thought, the safer plan will be to adopt immediate steps for the prevention of mischief. The patient should be bled generally, or locally by leeches and cupping, freely purged, kept on a low diet, and, above all, should remain quiet in bed for some days.

Should impairment of the mental faculties or senses be left, the more prudent plan will be to have recourse to mild antiphlogistic treatment. Leeching, cupping, blistering, the introduction of a seton in the nape of the neck, purgine, and more especially a mild mercurial course, with strict abstinence of all mental and bodily stimulation, is the plan of treatment that requires to be pursued. These cases must, however, be carefully watched,

and kept under proper supervision for some length of time, as serious symptoms are apt suddenly to declare themselves.

When *Acute Inflammation of the Brain or its Membranes* has come on, at whatever period after the injury, active treatment should be at once adopted. The head must be shaved, and an ice-bladder kept constantly applied. Bleeding from the arm, repeated as often as the pulse rises, as well as by cupping, or leeches, must be had recourse to; the bowels should be freely opened, and rigid abstinence must be enjoined, the patient at the same time being confined to a quiet and darkened room, and removed from all causes of excitement of the special senses. Calomel should then be administered, so as speedily to affect the mouth. As the disease assumes a chronic form, the same general plan of treatment, modified according to the intensity of the inflammatory affection, must be persevered in, the patient being kept for a length of time after the subsidence of all the symptoms in a state of complete quietude.

The *Subacute Encephalitis* which occasionally follows injuries of the head, even at a remote period from their infliction, is a most dangerous and unmanageable affection, being very apt to terminate in loss or impairment of sense, in diminution of intellectual power, or in local paralysis. Much of the difficulty in the treatment of these cases appears to arise from the fact that the inflammation is often of a low and erysipelatous character, consequently not admitting of active depletory measures.

In these cases the best results are obtained by the proper administration of mercury and the employment of counterirritants. The best mode of administering the mercury is to give calomel in small and repeated doses, half a grain or a grain every four or six hours until the gums are affected, and to keep them so by diminishing, but not leaving off the mineral. The repeated application of blisters over the shaven scalp is perhaps the most useful form of counterirritant; to which, in more chronic cases, a seton in the neck may be added. So long as any symptoms of inflammatory action continue, this plan of treatment must be steadily kept up.

The treatment of *Cerebral Irritation* that I have found most successful, consists in the avoidance of all very active measures. No good, but much harm, may result in these cases from bleeding, purging, and mercurialising the patient. Complete rest, the removal of all mental and sensual excitement, shaving the head, the application of cold, a mild aperient or an occasional enema, are all that can be done in the way of medical treatment. As the constitutional powers are depressed, they must not be too much lowered by complete abstinence from food, and small quantities of stimulants may usually be advantageously given. A tea-spoonful of brandy in a little water, or beef tea, every hour or two, according to the condition of the pulse and the temperature of the skin, will generally be required. In some cases, where there is great restlessness and some delirium, without any sign of encephalitis having supervened, an opiate may quiet the patient and induce sleep. This cerebral irritation is the only form of primary cerebral disturbance in which I have seen opiates act beneficially; but their administration requires great care, and must not be ventured on if there be any heat of head or quickness of pulse.

In all cases of *Coma from Compression*, the pressure must be relieved before it can be expected that the coma will subside. But besides this great and obvious indication, which must be carried out in different ways according to the nature of the compressing cause, there are certain general considerations to be attended to by which the patient's condition may be much relieved. Thus the bowels should be freely opened by placing a drop

of croton oil, mixed with a little mucilage, in the patient's mouth, or by the use of oleaginous or terebinthinate enemata. The urine is to be drawn off twice in the twenty-four hours, the room darkened, and kept quiet, and ice or an evaporating lotion applied to the head.

When symptoms of compression occur as the result of inflammation inside the skull, the treatment becomes surrounded by difficulties. If, notwithstanding antiphlogistic measures have been pushed to their full extent, rigors occur and coma supervene, conjoined with a certain amount of continuous inflammatory action, the question will always arise as to whether trephining should be had recourse to, on the supposition of matter having formed. In these cases two great difficulties present themselves; the first has reference to the existence of pus within the skull, and the second to its situation.

The question as to the actual existence of *Pus within the Skull*, and the dependence of the symptoms of coma upon the compression exercised by the purulent deposit, is always a difficult one to determine. There are, as has already been stated, no absolute and unequivocal symptoms indicative of the formation of pus within the skull; the same symptoms that accompany its formation being often closely simulated by the effusion of serum, or of puriform lymph, on the brain or its membranes. But, although there may not be any symptom that is absolutely and unequivocally indicative of the formation of pus in this situation, it not unfrequently happens that the surgeon is enabled, by the assemblage of general symptoms and local signs, to indicate its existence with considerable accuracy (p. 89). In these cases, however, it is usually impossible to determine the exact seat of the purulent deposit with sufficient precision to admit of its evacuation by the trephine—whether the pus be between the skull and the dura mater, between the layers of the arachnoid, underneath this membrane, between the cerebral convolutions, or deeply seated in the substance of the brain; whether it be situated under the seat of injury, and be there circumscribed; or whether it be so extensively diffused as not to be capable of complete evacuation. That these difficulties are real, must be obvious to every practical surgeon; and in illustration of them I may mention the following two cases, out of many that I have witnessed.

A man was admitted into University College Hospital with an extensive lacerated wound of the scalp, denuding the pericranium. He continued free from all cerebral disturbance until the tenth day after the accident, when he complained of headache, had quick pulse, and a hot skin. At this time, it was observed that the denuded pericranium had separated from the skull. He was treated by active antiphlogistic means, the symptoms subsiding, and went on favourably until the thirty-fourth day, when he suddenly became delirious and unconscious, though easily roused when spoken to loudly, and then answering rationally; his pulse fell to 48. He died on the thirty-ninth day, comatose. On examination after death, the pericranium was found detached at the seat of injury; under this the dura mater was thick, yellow, and opaque, but no pus was observable. On separating the hemispheres, however, a large abscess was found situated deeply in the anterior lobe on the injured side, and protruding into the median fissure. It contained about one ounce of pus. In such a case as this, trephining would evidently have been useless; for, although it was probable that there was pus within the skull, yet its seat could not have been diagnosed, and the abscess would never have been reached.

Another case that was admitted into the hospital, was that of a man who had received a large lacerated wound on the left side of the scalp in con-

sequence of a fall. There was no injury to the bone, and the patient went on perfectly well until the seventy-seventh day, the wound cicatrising. He was then suddenly seized with hemiplegia of the right side, from which he recovered partially on being bled; some twitching of the muscles, however, continued. On the ninety-ninth day after the accident he became comatose, and was trephined by Mr. S. Cooper, but without relief, dying with symptoms of compression of the brain on the third day after the operation. On examination, thick yellow lymph was found, covering the whole of the upper surface of both hemispheres, lying between the arachnoid and pia mater, and extending into the sulci between the convolutions. There was an abscess in the substance of the brain on the surface of the right hemisphere, on the side opposite to the seat of injury. Here also, though the symptoms were well marked, and the diagnosis as to the existence of pus correct, trephining was useless, as the pus could not be evacuated. These cases serve to indicate the difficulties that surround any operation with the view of evacuating matter from within the cranium.

When, however, the symptoms of inflammation have been interrupted by an attack of rigors followed by coma, or accompanied by hemiplegic paralysis on the side opposite to the seat of injury, with the formation of a puffy swelling of the scalp, or by the separation of the pericranium and the exposure of yellow and dry bone at the bottom of the wound, there can be little doubt that the surgeon, though bearing in mind the extreme uncertainty of the case, might be justified in trephining at the seat of local change or of injury, in the hope of finding and evacuating pus deposited beneath the skull, and thus giving the patient his only chance of life. And indeed, if the local changes just described be well marked, the bone being dry, having lost its vitality, and during the operation being cut without bleeding from the diploe, the probability of finding pus immediately beneath the trephine aperture, and seeing it well up by the side of the instrument as the bone is perforated, is very great. And should it not be met with there, and the dura mater appear bulging, and without pulsation, an incision might even be made through this membrane, in the hope that, the abscess being circumscribed, the escape of the pus might be facilitated. Should this attempt fail, there are few surgeons who would have the hardihood to follow the example of Dupuytren, who plunged a bistoury into the substance of the brain, and thus luckily relieved the patient of an abscess in this situation. Yet, even though pus be actually found under the skull, between it and the dura mater, and be evacuated, I fear that the patient's chances of recovery will not be very materially increased, as the encephalitis will continue, and eventually lead to his death. In my own experience I have never met with a case of recovery under these circumstances; and P. Hewett states that the successful termination of a case of trephining for pus within the skull, even between it and the dura mater, is all but unknown to surgeons of the present day. Yet, in the face of this unfavourable prospect, it appears to me that trephining is the proper course to pursue. There can be no doubt from the records of surgery, that patients have occasionally recovered who have been trephined for intracranial suppuration; and, as the pus cannot evacuate itself, it is perfectly correct that death must ensue if it be not let out. As the only chance of life therefore rests with the trephine, it appears to me to be proper to have recourse to this, however doubtful may be the result of its application.

The Treatment of Pyæmia from injury of the skull must be conducted on those ordinary medical principles that guide us in the management of pyæmia, from whatever cause arising. There is only one point of a purely surgical

character connected with it, and it is this: Should recourse be had to trephining in cases of contusion of the cranium as a means of preventing the development of pyæmia? In answer to this, I would say that, as experience has not demonstrated the utility of this procedure; as it would be impossible in any given case of contusion of the cranium to say whether necrosis or suppuration of the bruised bone would occur; as it would be still more difficult to limit the extent of that probable necrosis, and to remove it all by the trephine; and as the operation itself is attended by grave dangers of its own, and would inflict an additional injury on the diploe, it could scarcely be considered as likely to be attended by any benefit in rescuing the patient from the possible danger of pyæmia; and in the face of such uncertainties and of such possible dangers, so serious an operation as trephining the skull would not be justifiable.

INJURIES OF THE SCALP.

CONTUSIONS OF THE SCALP from blows are of common occurrence, and present some peculiarities that deserve attention. However severe the contusion may be, it seldom happens that the scalp sloughs. This is evidently owing to the great vascularity and consequent active vitality of the integuments of the head. In many cases a contusion in this situation is followed by considerable extravasation of blood, raising up the scalp into a soft semi-fluctuating tumour. It occasionally happens, especially in blows on the heads of children, that this extravasation gives rise to the supposition that fracture exists, owing to the edge of the contusion feeling hard, whilst the centre is soft, apparently from the depression of the subjacent bone. In some cases, indeed, this deceptive feeling will occur without any considerable extravasation of blood under the scalp, the depressed centre being due to the compression of the scalp by the blow that has been inflicted upon it. Thus I have seen occasionally in children in whom the scalp is soft and somewhat spongy. The difficulty of distinguishing between such an extravasation and a piece of depressed bone, is often so great as to mislead the most experienced surgeons. Usually it can be effected by feeling the smooth bone at the bottom of the soft central depression, and by an absence of symptoms of compression. But in the event of doubt, it will be safer to make an incision, and so to examine directly the state of the bone itself.

The Treatment of contusion of the scalp is very simple; the continuous application of evaporating lotions being usually sufficient for the removal of all effusion. Under no circumstances should a puncture be made, or the blood let out in any way. Contusions of the scalp in girls and young women have been known to be followed by severe neuralgic pains in the part struck. This affection is extremely rebellious to treatment; but in two cases which I have seen, after lasting for a considerable length of time, these symptoms gradually disappeared; in such cases as these, incisions down to the bone are said to have sometimes been beneficial.

CEPHALÆMATOMA.—It occasionally happens that bloody tumours of the scalp form in newly born children, either from contusion of the head in consequence of the pressure to which it is subjected in its passage; or else by the bruising of obstetric instruments. These tumours, which are often of large size and fluctuating, are termed *cephalæmatomata*. They may occur in two situations, either between the aponeurotic structures of the scalp and the pericranium, or between this membrane and the skull itself.

The *Subaponeurotic Cephalæmatoma* is by far the most common variety of the affection. It usually forms a large soft fluctuating tumour, situated upon one of the parietal eminences, and having a somewhat indurated

circumference. The tumour may usually be made to subside in a few days by the use of discutient lotions.

The *Subpericranial Cephalematoma* is an injury of extremely rare occurrence; but Zeller, Valleix, and others, have determined its existence. It appears as a fluctuating tumour, without discoloration of the scalp, but with a hard elevated circle around it, and a soft depressed centre, almost communicating the sensation of a hole in the cranium. Pressure, however, gives rise to no cerebral symptoms, and enables the surgeon to feel the osseous lamina at the bottom of the depression. These tumours are usually of small size, seldom larger than a walnut, and it not uncommonly happens that they are multiple. It is worthy of note, however, that each tumour is always confined to a separate bone, never passing beyond the sutures, where the adhesions are the strongest between the pericranium and the subjacent osseous structure. This affection is said to be most frequently met with in children born in first confinements, and is more common in boys than in girls; according to Bonchard, in the proportion of thirty-four to nine.

The *Pathology* of this affection has been studied by Valleix. This surgeon found that the pericranium was separated from the bone by an extravasation of blood, and that both bone and pericranium were covered with plastic matter, but otherwise healthy. He also found that the hard circle surrounding the depression was formed by a deposit of osseous and plastic matter which bounded the extravasation. This deposit was effected in such a way that, on a transverse section being made, the inner wall was found nearly perpendicular, whilst the outer sloped down upon the cranium, thus giving a crateriform appearance to the margin of the tumour.

The *Treatment* of this affection must be conducted on precisely the same principles as that of the other forms of scalp-extravasation.

WOUNDS OF THE SCALP are of very common occurrence, and are more serious than corresponding injuries elsewhere, especially in persons about the middle period of life and of unhealthy or broken constitution. It is not only that these injuries are more likely to be followed by erysipelas than those of other parts of the body, but it is also the great tendency to the propagation of inflammatory mischief inwards to the encephalon, and to the complication of cerebral mischief, so often accompanying comparatively slight injuries of the scalp, that these accidents owe much of their serious and often fatal character. But, though there be this danger to life in scalp-injuries, there is comparatively little risk to the scalp itself; the abundant supply of blood which it receives from closely subjacent arteries, and its consequent great vitality, furnish the reason why sloughing so seldom occurs, even though the part be much bruised and seriously lacerated.

The *Treatment* of wound of the scalp necessarily varies somewhat according to the nature of the injury. If this be a simple cut, it will be sufficient, after shaving the parts around and cleansing its interior, to bring it together with a strip or two of adhesive plaster, and to dress it as lightly as possible. If the incision in the scalp be extensive, the lips of the wound must be brought together by a few points of metallic suture, or by harelip pins. If there be arterial hemorrhage, this may usually be best arrested by passing the pins across and under the bleeding vessel, and compressing this with a figure-of-8 suture. In this, as in all other cases of injury of the head, especial attention should be paid to the state of the brain; for, however slight the external wound may be, serious cerebral mischief may have been occasioned; or, at all events, the same blow that has caused the cut in the scalp may have given rise to such functional derangement of the brain, as may eventually lead to the worst forms of traumatic encephalitis.

It more frequently happens that the scalp is bruised and lacerated as well as wounded; and very commonly that a large flap of integument is stripped off the skull, and is thrown down over the face or ear, so as to denude the bones. In these cases, advantage is taken of the great vitality of the scalp. However extensively contused or lacerated this may be, however much it may be begrimed with dirt, it is a golden rule in surgery not to cut any portion of it away, but, after shaving the head and ligaturing any bleeding vessels, to wash and clean it thoroughly, and replace it in its proper position. Here it must be retained by the support of a few strips of plaster, or by the application of a suture or two at the points of greatest traction: for this purpose, thick silver-wire is better than silk or thread. The use of sutures has been deprecated by many surgeons in injuries of the scalp as tending to favour erysipelas; and undoubtedly much mischief will arise if an attempt be made to stitch up the wound closely, and in small wounds they are generally unnecessary. But in extensive lacerations, more particularly of the anterior part of the scalp, so that the soft parts are stripped off, and will hang over the occiput as the patient lies down, they cannot be dispensed with, and here I have never seen any but the best consequences follow their use at those points where the torn surfaces can be readily approximated. In cases of this kind, the under surface of the scalp granulates, and union by the second intention takes place between it and the skull. If the edges do not come properly together, a piece of water-dressing may be applied; but the head must be kept cool, and as little bandaging and plastering had recourse to as possible. The patient should be freely purged, and kept perfectly at rest on rather a low diet; any cerebral symptoms that occur being treated in accordance with the principles laid down in discussing traumatic affections of the brain. In this way, union will very probably take place through the greater portion of the injured surface; should it not do so, however, or should any part slough, granulations spring up, and reparative action goes on with surprising rapidity. If matter form beneath the aponeurosis of the occipito-frontalis muscle, bagging must be prevented by early counter-openings, and by the employment of compression in proper directions. Whenever suppuration takes place beneath the frontal portion of the scalp, the pus has a special tendency to gravitate into the upper eyelid, and here the counter opening may be conveniently made. If simple erysipelas supervene, that disease will require to be treated in accordance with ordinary surgical principles. So far as the wound in the scalp is concerned, that must be thrown open, all dressings removed, and, if matter form, a free outlet must be afforded to the pus. If diffuse cellulitis occur, recourse must be had to free incisions through the puffy and swollen scalp, and counter-openings for the discharge of pus and sloughs.

When the skull is extensively denuded in consequence of the scalp with the subjacent pericranium being stripped off, we need not necessarily expect that necrosis and exfoliation of the exposed bone will occur. In cases of this kind the flap must be laid down on the denuded osseous surface, to which it may possibly contract adhesion. Should it, however, slough, and a large portion of the skull be exposed, exfoliation of the outer table may, but does not necessarily, happen; for, instead of exfoliating, the exposed portion of the skull will inflame, plastic matter be thrown out, and thus, granulations springing up, a covering be formed to the bone.

CONTUSION OF THE CRANIAL BONES without fracture, occasioned either by ordinary direct violence or by the oblique impact of bullets, is a very serious injury, more particularly when complicated with wound of the scalp. In it there are three sources of danger, any one of which may be followed by

a fatal result; viz.: 1. Necrosis of the part of bone struck, leading to exfoliation of the outer table, or to separation of the whole thickness of the cranium and exposure of the dura mater; 2. Suppuration under the skull, between it and the dura mater; and, 3. Pyæmia with secondary visceral abscesses, in consequence of the suppuration of the diploe around the necrosed point of bone, and the entrance of pus into the cranial veins,—a condition which has already been referred to.

FRACTURES OF THE SKULL.

Injuries of the bones of the skull, especially fracture, possess great interest, not so much from the lesion of the bone itself, as from its frequent complication with injury of the brain and its membranes. Thus cerebral complication may either be produced by direct injury, occasioned by the fragments of the fractured bone compressing or wounding the brain; or it may be the result of concussion or laceration of the brain by the same violence that occasions the fracture.

CAUSES AND VARIETIES.—Fractures of the skull are invariably the result of external violence. This may act *directly* in breaking and splintering the part struck, the fissures often extending to a considerable distance and detaching large portions of the skull; or the violence may act in an *indirect* manner, producing the fracture either without being applied immediately to the cranium, or else at an opposite part of the skull to that which is struck. Thus the base of the skull may be fractured by the shock communicated to it when a person, falling from a height, strikes the ground heavily with his feet. The other variety of indirect fracture, that in which the solution of continuity occurs at a point of the skull opposite to that which has been struck, is the *fracture by contrecoup*.

FRACTURE BY CONTRECoup.—This has been described by some surgeons as of frequent occurrences, whilst it has been denied by others. There can, however, be no doubt that it does happen, though less commonly, perhaps, than is generally supposed. Every hospital surgeon must occasionally have seen unequivocal instances of it. For its occurrence, several conditions are necessary. The skull must be struck over a large surface, as when a person falls with his head against the ground. If the blow alight on a thin portion of it, this will be directly fractured; but if a dense and strong part of the bone be struck, as the parietal eminence, or the lower part of the os frontis, the shock transmitted through the skull generally will cause the thinnest and most brittle portions of it, though distant, to give way in preference to the stronger part on which the blow has immediately fallen. The fracture by *contrecoup* is most common at the base of the skull, and is commonly much radiated. It is never depressed.

SIMPLE FRACTURE.—An ordinary simple or *undepressed* fracture of the skull consists in a fissure, sometimes single, at other times starred, extending often to a considerable distance through the bones, radiating sometimes across the skull, and in other cases completely detaching its upper from its lower, or its anterior from its posterior segment. In some cases the fracture extends into one of the sutures; and in other instances, which, however, are very rare, the sutures are separated without any fracture.

The injury usually occurs from direct violence, but is also the only form of fracture that happens by *contrecoup*. A simple fracture, such as this, gives rise to no signs by which its diagnosis can be effected. If, however, the scalp covering the injured bone have been wounded, its existence may be ascertained by running the finger-nail, or the end of a probe, over the exposed *surface of the bone*, or by seeing a fissure into which the blood sinks.

In the simple undepressed fracture, no special Treatment is required to the fracture itself, the surgeon's whole attention being directed to the concomitant injury that may have been inflicted on the brain or scalp. Active precautionary measures should be adopted without delay, with the view of guarding against the occurrence of inflammation of the brain and its membranes, even though no symptoms have as yet declared themselves. So soon as the patient has recovered from the concussion, his head should be shaved, an ice-bladder applied, and blood freely taken away from the arm; the bowels should be well opened, and the room kept cool and quiet. The employment of free and repeated bleeding is, however, of more service than any other means, and should never be omitted.

In *chronic hydrocephalus*, the cranial bones are thinned and expanded; but being at the same time preternaturally elastic and mobile, are seldom fractured. When they are so injured, the presence of the water may save the brain from the direct effects of the blow. In one case that was under my care, the hydrocephalic child fell from the top of a house on to its head, and sustained a long fracture through the left side of the skull, but without any scalp-wound. Shortly after the accident, a large soft fluctuating tumour formed under the scalp opposite the line of fracture; and, on this being tapped, about three ounces of hydrocephalic fluid were drawn off. This operation was repeated, but the child died about ten days after the injury, with hemiplegia of the opposite side, and convulsions.

FRACTURE OF THE BASE OF THE SKULL.—The most serious, and indeed a very commonly fatal form of simple fracture of the skull, is that which extends through its base. This injury is usually produced by a fall from a height or a blow upon the vertex or side of the head, producing a fracture which extends from the point struck across the base of the skull, often running through the petrous portion of the temporal bone or into the foramen magnum. It may also take place as the result of *contrecoup*, or from a person falling from a height on his head, and having the base of the skull broken in by the weight of the body projected against it. The great danger in these cases is the concomitant injury to the brain, either by its direct laceration or by the extravasation of blood upon it. Though most usually fatal, these injuries are not invariably so. Not only does it occasionally happen that patients with all those signs of fracture of the base of the skull, which will immediately be described, are seen to make a complete recovery, but, in the different museums, specimens illustrative of recovery after this accident may be met with. Thus, in the College of Surgeons' museum, there is the skull of a person who lived two years after a fracture of its base.

Signs.—The occurrence of fracture of the base of the skull is very commonly suspected when symptoms indicative of serious injury to the brain speedily follow a severe blow upon the head, owing to the greater liability to injury of those parts of the nervous centre that are most important to life, in this than in other fractures of the skull; the same violence that occasions the fracture injuring the contiguous portions of brain, or lacerating some of the large venous sinuses about the base of the skull, and thus giving rise to abundant extravasation of blood. These symptoms are necessarily in the highest degree equivocal; and much anxiety has been evinced by surgeons to discover some special sign by which the occurrence of this particular fracture may be determined.

The signs of fracture of the base of the skull will necessarily vary according to the seat of injury. When the fissure extends through the anterior fossa, there may be extravasation of blood into the orbit or eyelid, or free hemorrhage from the nose. When it implicates the middle fossa, there is,

in all probability, fracture of the petrous portion of the temporal bone, with rupture of the tympanum, and then there will be bleeding or a watery discharge from the ears. When the *posterior fossa* is the seat of injury, the signs are more equivocal, unless the fissure extend inwards to the petrous portion of the temporal bone, when the more characteristic signs will occur.

There are two signs, the occurrence of which, separately or together, leads to strong presumptive evidence in favour of the existence of this kind of fracture. These are, 1. The Escape of Blood from the interior of the cranium through the ears, nose, or into the orbit; and 2. The Discharge of a *Serous* Fluid from the Ears, and occasionally from other parts in connection with the base of the skull.

1. The occurrence of *Bleeding from the Ears* after an injury of the head cannot by itself be considered a sign of much importance, as it may arise from any violence by which the tympanum is ruptured, without the skull being necessarily fractured. If, however, the hemorrhage be considerable and continuous, and more especially if it be associated with other symptoms indicative of serious mischief within the head, and if it have been occasioned by a degree of violence sufficient to fracture the skull, we may look upon its supervention as a strong presumption that a fracture of the base of the skull, extending into the petrous portion of the temporal bone, has taken place, and that, perhaps, one of the venous sinuses in its neighbourhood is torn.

Hemorrhage into the Cellular Tissue of the Orbit and Eyelid, giving rise to extensive ecchymosis of the lid, possibly with protrusion of the eye-ball itself, often accompanies fracture of the roof of the orbit. The ecchymosis that occurs in these cases arises from the filtration of the blood from the interior of the skull, through the fracture, into the loose cellular tissue contiguous to the injured bone. It differs remarkably in appearance from that resulting from a direct blow upon the eyelid—from a “black eye.” In the latter case there is bruising of the skin, and the ecchymosis is in a great measure cutaneous, of a reddish purple colour. In the ecchymosis from fracture, the hemorrhage is entirely subcutaneous: there is probably no bruising of the eyelid, but this is tense, greatly swollen, and of a purple colour. The extravasation can clearly be seen not to be in the skin, but to shine through it.

This hemorrhage may be venous or arterial. When arterial, it may, as Hewett has shown, be the forerunner of a circumscribed traumatic aneurism of the orbit, attended by pulsation, bruit, and projection of the eyeball, requiring the deligation of the common carotid for its cure.

Bleeding from the Nose or Mouth may of course arise from any injury applied to this organ without the skull being implicated; yet in some cases of fracture of the skull the hemorrhage proceeds from the interior of the cranium, the blood escaping through a fissure in the roof of the nasal fossae. In a patient of mine who died five weeks after an injury of the head, accompanied by bleeding from the nose, a fracture by *contrecoup* was found extending across one orbital plate of the frontal bone, and separating its articulation with the ethmoid. In this case, the nature of the injury was suspected from the fact of the nose itself having been unimjured by the blow, although the hemorrhage from it was very considerable and continuous; for it is in the quantity and duration of this hemorrhage that its value as a diagnostic sign of fracture of the base of the skull consists.

Vomiting of Blood may occur in these cases, from the blood finding its way into the pharynx and stomach. In some rare cases, the blood that issues from the nose and mouth passes into these cavities through the Eustachian tube. The petrous portion of the temporal bone is fractured, and

the middle ear opened. The tympanic membrane was perforated by the ear candles, but the water escaped from the middle ear in a constant flow.

2. The discharge of a watery fluid from the ear is not a new sign of rarefaction of the air in the middle ear, but a certain sign of the middle ear disease. The middle ear may pass through the ear, and a watery fluid may be seen to flow out, one instance, and Robert mentions another. The middle ear may pass from a wound in the ear, and the middle ear may be found passing through the ear, and a watery fluid may be seen to flow out, this kind with which I am acquainted, and which was observed only by one of the people of the house in which I was living, in February a few years ago. A man, a Frenchman, a native of the island, with depressed and depressed features in the skull, at the seventh day after the receipt of the wound, a large quantity of water began to escape through the wound, and continued to flow out until his death from some later cause. At first the fluid was watery, and usually tinged with blood, but the smell changed, and it was more

There would consequently appear to be three situations—the ear in the head, and a wound on the head—both with the middle ear being exposed. It is an exceedingly valuable though rare source of information, and has been investigated this phenomenon with great interest, and it is not at all clear what it happens always, or whether it is not a sign of a more serious condition. The Frenchman was a native of the island, and at least two cases have occurred in the Frenchman's house, a wound the patients recovered, although many cases of fatal result have occurred in the ear. It is usually associated with symptoms indicative of disease of the bone of the head, but in the three cases mentioned above, it has been seen to take place in cases of injury of the head, and in cases of severe cerebral symptoms. Most recently I have seen a very young Frenchman says that it does so frequently, and Robert says that it is one of the instances in which he has seen it the patients were about eight years of age. In one of the cases that I have witnessed, the patient was about eight years of age, and in four other instances in which I have seen it, the patients were all adults.

The quantity of fluid that is thus discharged is often very considerable, the pillow usually becoming saturated, and the head becoming sore to it. It is often necessary to keep a piece of sponge or a piece of cloth against the ear, in order to prevent the fluid from running down the neck, and, if a cup be so placed as to collect it, an odor of a very peculiarly accumulative. Laugier states that he has seen a considerable quantity in a short time, and as much as twenty drops have been seen to flow out in three days. The fluid is usually watery, and is often tinged with blood. It is remarkable that the hearing, though usually lost, does not always appear to be destroyed in the ear from which the discharge issues.

Although the occurrence of a watery discharge from the ear after injury of the head had been observed by Laugier, and others, and Dr. Dumas, in the early part and middle of the last century, no attention was paid to the subject by later surgical writers, and the subject has been completely lost sight of until Laugier in 1809, again directed the attention of surgeons to this interesting phenomenon. Since the period it has been often observed and attentively studied, and the nature and the source of this discharge have been particularly investigated by Laugier, Broussais, Malgaigne, and Guthrie. Its physical and chemical characters are those of a

perfectly clear, limpid, and watery fluid, containing a considerable quantity of chloride of sodium, with a little albumen in solution, and some sugar. It is not coagulable by heat nor by nitric acid.

The source of this discharge has not as yet been investigated with all the attention that its importance requires. Laugier believed it to be the serum of the blood filtered through a crack in the petrous portion of the temporal bone, and so through the ruptured tympanum. This explanation, however, is evidently not correct; for not only is blood extravasated in the living body incapable of this species of rapid and complete filtration, but the chemical composition of the fluid, which differs altogether from that of the serum of the blood, in containing a mere trace of albumen and double the quantity of chloride of sodium, is incompatible with this supposition. By others it has been supposed that the fluid is furnished by the internal ear, being a continuous discharge of the liquor Cotunni; but its large quantity, and, above all, the fact of its occasionally escaping through the nose, establish the fallacy of this explanation. Again, it has been supposed, but without sufficient evidence, that the cavity of the arachnoid furnishes this secretion. But the arachnoid does not secrete sufficiently to furnish the quantity of fluid discharged; and if this membrane became irritated and the secretion increased, it would become opaque from lymph or pus admixed with it. Others have looked upon it as the saliva flowing back through the Eustachian tube, and thus entering the ear, and draining out through the ruptured tympanum; but the character of the fluid differs so completely from that of saliva as to render this supposition untenable. I think, with Robert, that there can be little doubt that this discharge consists of the cerebro-spinal fluid; for not only is it, in appearance and chemical composition, identical with this liquid, but there is no other source within the skull than the pia mater which can yield with equal rapidity so large a quantity of fluid: experiment on animals having shown that the cerebro-spinal fluid is rapidly reproduced after its evacuation. An additional point of analogy between this discharge and the cerebro-spinal fluid is to be found in the fact pointed out by C. Bernard, that they both contain a small quantity of sugar. In order that the fluid be discharged, the membranes of the brain must have been torn opposite the outlet by which it is poured forth. This has actually been ascertained to be the case, in carefully conducted dissections of injuries of the head in which this symptom has occurred. When it is discharged through the ear, the laceration, as Bernard has remarked, must have extended through the cul-de-sac of the arachnoid, which is prolonged around the auditory nerve in the internal auditory canal. When it is poured out through the nose, the fracture has probably extended through the cribriform plate of the ethmoid bone, and laid open the prolongation of arachnoid that surrounds the filaments of the olfactory nerve.

Treatment.—The treatment of fracture of the base of the skull must be conducted on those general principles that guide us in the management of simple fractures; no special means can be had recourse to, and in the great majority of cases a fatal termination speedily ensues.

DEPRESSED FRACTURE OF THE SKULL.—It occasionally though very rarely happens that, in consequence of a blow, a portion of the skull is depressed without being fractured, and even without any serious symptoms occurring. Thus, Green mentions a case in which the bowl of a dessert-spoon might be laid in the hollow produced in the skull by a blow, and no symptoms resulted. Depression without fracture can, however, only occur in children, whose skulls are soft and yielding. In adults it cannot happen without the occurrence of partial or incomplete fracture. It must be borne in mind,

however, that the apparent depression produced by an extravasation under the scalp, may simulate this injury very closely; and even an experienced surgeon may sometimes under these circumstances be deceived, and be induced to cut down on a suspected fracture when in reality none exists.

Varieties.—Depressed fractures of the skull present many varieties. They may either be simple, without wound of the scalp, compound, or comminuted. In the majority of cases, whether the fracture be simple or comminuted, there is comminution of the injured portion of bone; the fragments being perhaps driven into the brain.

Sometimes, though very rarely, the external table alone is depressed. This is especially the case over the frontal sinusses, where it may be broken in, as I have seen happen from the kick of a horse, without the inner table being splintered, or any bad consequences ensuing. Much more commonly, however, the inner table is driven in with comparatively little injury to the outer one; it has, indeed, been stated that a portion of the inner table may be depressed without there being any fracture of the external one; this, however, can scarcely occur, though it may happen with but a very trifling fracture of the outer table.

In all ordinary depressed fractures, the internal table is splintered to a greater extent than the external one. This is especially the case when the fracture is the result of gun-shot injury, or when it has been occasioned by blows with a pointed weapon, as the end of a pick, or a large nail, or the sharp angle of a brick. In these fractures, which constitute the dangerous variety termed *Punctured*, the outer table may be merely perforated or fissured, whilst the inner one is extensively splintered. This splintering of the inner lamina of the skull to a greater extent than the outer one has attracted much attention, being of considerable practical moment, and is usually said to be owing to its being more brittle than the external table. This, however, I do not consider to be the only cause. I should rather attribute it to the direction of the fracturing force from without inwards causing a certain loss of momentum in passing through the outer table; the inner table being thus splintered more widely than the outer one, for the same reason that the aperture of exit made by a bullet is larger than that of entry. If this be the true explanation, the reverse ought to hold good if the force be applied in the opposite direction. It is very seldom that we have an opportunity of examining such a case; but a few years ago a man was brought to the hospital who had committed suicide by discharging a pistol into his mouth and upwards through the brain. The bullet had perforated the palate and passed out at the upper part of the cranium, near the vertex (Fig. 141). On examining the state of the bones, it was found that the outer table of the skull was splintered to a considerably greater extent than the inner one, showing clearly the influence of the direction of the fracturing force. I have since found, by experiment on the dead body, that this is most generally the case when the blow is struck from the inside of the skull outwards.

It occasionally happens as the result of sabre- or hatchet-cuts on the head, that a kind of longitudinal punctured fracture occurs, in which the outer table



Fig. 141.—Fracture of the Skull from Gun-shot Injury—splintering of Outer Table.

is merely notched, whilst the inner one is splintered along the whole line of blow. In other cases, again, a portion of the skull is completely sliced off, hanging down in a flap of the scalp, and exposing the brain or its membranes.

The *Symptoms* of a depressed fracture of the skull are of two kinds: those that are dependent upon the injury to the bone, and those that result from the concomitant compression or laceration of the brain.

When the scalp is not wounded, the depression may sometimes be felt; but very commonly it is masked by extravasation of blood about it, and the surgeon is only led to suspect its existence by the continuance of symptoms of compression from the time of the injury. In all cases of doubt, when these symptoms exist, an incision should be made through the scalp at the seat of injury, and the state of the skull examined. When there is a wound in the scalp communicating with the fracture, the surgeon detects at once the existence of depression and comminution by examining the bone with his finger through the wound. When the fragments that are depressed are impacted and brinly locked together, so as to form an unyielding depression, symptoms of compression of the brain, to a more or less marked degree, usually result. But if the fracture be very extensive, and the fragments, though somewhat depressed, lie loose, and if they be yielding and do not exercise a continuous pressure on the brain, it occasionally happens that no cerebral disturbance comes on for some days, even though the injury done be very extensive. A man, twenty-four years of age, was admitted into University College Hospital. He had been struck on the forehead with the sharp edge of a quoit. The frontal bone was extensively comminuted, twelve fragments being removed, and the dura mater being exposed to a considerable extent; yet no bad symptoms occurred until the ninth day, when inflammation of the brain and its membranes set in, and he speedily died.

In other cases again, more especially in children and young persons, in whom the bones are soft and yielding, fracture with depression may exist to a considerable extent, and no symptom whatever of compression be produced at the time or at any subsequent period,—the patient living with a portion of his skull permanently beaten in.

Wounds of the Dura Mater.—The great danger in these cases of depressed and comminuted fracture arises, however, not only from the compression of the brain, but from the rapidity with which inflammation is set up in consequence of the sharp fragments wounding and irritating the membranes and brain. Indeed, a wound of the dura mater, however slight, is a most dangerous complication, and one that is not often recovered from. This is more especially the case in those injuries in which the inner table is extensively splintered, as in the different forms of punctured fracture. In these cases there may be no signs of compression; but inflammation speedily sets in, and certainly proves fatal if the cause of irritation, the sharp spicula, be allowed to remain in contact with the dura mater. This membrane becomes sloughy, and coated with a thick deposit of plastic matter, whilst the usual evidences of encephalitis are found in the other membranes and the brain. Wounds of the dura mater, though in the highest degree dangerous, are not necessarily fatal. In military practice it has often happened that, as the result of sabre cuts, portions of the skull have been sliced or split down, the subjacent membranes and the brain itself being wounded, and yet a good recovery has resulted; and I have had several cases under my own care in which, though the dura mater has been punctured by spicula of depressed fractures, and portions of brain lost, the patient has made a good recovery.

The *Treatment* of a depressed and comminuted fracture of the skull varies

not only according to the nature and extent of the accident, but also to the existence or absence of symptoms of compression of the brain.

If there be no wound in the scalp, but the occurrence of symptoms of compression and the existence of some irregularity of the skull at the seat of injury lead the surgeon to suspect a depressed fracture, he should make a crucial or T-shaped incision down upon the part in order to examine the bone, and, if thus be found depressed, to elevate or remove it.

If the scalp be already wounded, all that need be done to ascertain the nature of the fracture, is to pass the finger very gently into the wound and thus examine the bone. If any fragments be found lying loose, they should be picked out, as their presence can only excite injurious irritation; any bone that is driven below its level must be raised, and, if completely detached, removed.

In order to raise these depressed portions of bone, it is in many cases only necessary to introduce the point of an elevator underneath the fragment, and, using the instrument as a lever, raise it into position. If there be not an aperture sufficiently large for the introduction of the elevator, one may be made by sawing out an angle of bone at a convenient spot by means of a Hey's saw, or clipping off a projecting point with the bone-forceps. In this way, sufficient space may usually be gained without the necessity of applying the trephine. If, however, the inner table be splintered to a considerable extent, or if there be no convenient angle that can be removed, the trephine must be applied in such a way that at least half its circle is situated upon the edge that overhangs the depressed bone; the surgeon sawing out by means of this instrument a portion of the undepressed skull, in order that he may more conveniently get at the fragment. After a half circle of bone has been removed in this way, the depressed splinters may be taken out, a Hey's saw still being occasionally required before the whole can be removed; the flaps of scalp should then be laid down, a suture or two applied, and water-dressing put over the wound. Rigorous antiphlogistic treatment must then be adopted with the view of preventing or removing the inflammatory symptoms which set in.

In all cases that partake of the nature of a *Punctured Fracture*, those in which there is but slight injury of the external table, with considerable splintering and depression of the inner one, or in which there is a narrow and deep depression of the bone, the trephine must be applied on different principles from those that guide us in its use in ordinary depressed fractures. In the punctured fracture it is applied, not to remove symptoms of compression which, in all probability, may not exist; but with the view of preventing the inflammation which will to a certainty be set up if the splinters of the inner table be allowed to continue irritating the membranes and brain. Hence it is a rule in surgery, in all cases of punctured fracture, to apply the trephine at once, so as to prevent those injurious consequences which must otherwise necessarily result. In these cases a trephine with a large crown should be used, and the circle of injured bone itself must be sawn out.

Should, however, the use of the trephine have been delayed in these cases until inflammatory action have been set up, the instrument may still be applied with advantage. Some years ago, a boy was admitted into University College Hospital, on the sixteenth day after having been struck on the side of the head by a large nail, which projected from a door that fell upon him. No symptoms of any kind had occurred until the eleventh day after the accident, when he became dull and lost his appetite; on the sixteenth day, that of his admission, he had suddenly become drowsy and

delirious, but answered rationally when spoken to, and complained of pain in the head. The pupils were dilated, the skin hot, and the pulse quick. On examination, a small round aperture, from which some fetid pus exuded, was discovered on the right parietal eminence. On introducing a probe, which the hole just admitted, some rough bone could be felt. Mr. S. Cooper immediately trephined the boy, removing a circle of bone including the small aperture. The inner table corresponding to this was found splintered to some extent, and the dura mater was seen to be thickened and inflamed; but the patient recovered without a bad symptom.

In those rare cases in which there is a *depressed fracture, without symptoms of compression*, or even a wound of the scalp, the line of practice is somewhat unsettled, as to whether the depressed portion of bone should be left where it is, or an attempt be made to elevate it. Sir A. Cooper, Abernethy, and Dupuytren advise that, if it give rise to no symptoms of compression, it is better not to interfere with it; and there are several cases on record of patients who have recovered in whom this course was adopted, the depression continuing permanent. That non-interference is the proper course to pursue in some cases, more particularly in children, there can be no doubt. I have had under my care a child in whom, in consequence of a fall, there was on one of the parietal bones a depression as large as a crown-piece, its edges being sharply defined: no signs of compression or of inflammation of the brain ensued, and it was consequently left without interference, the child making an excellent recovery, and continuing well. Indeed, in children, the amount of injury that may be inflicted on the brain, not only by compression but by actual laceration, and yet be followed by recovery, is very surprising.

In the adult, the cerebral substance does not accommodate itself so readily to injuries, and here the line of practice is not quite so definite. But even in persons of mature age, under certain favourable circumstances, bone may be depressed and continue so without giving rise either to compression of the brain or to inflammation of its membranes. I lately had under my care a case which illustrates this point forcibly. The patient, a middle-aged man, fell on his head into an area, and stripped off the greater part of the scalp from the anterior part of the head and the vertex; on the upper part of the left parietal bone was a starred and depressed fracture of the skull, as large as a florin. As the depression was smooth, not more than a quarter of an inch in depth, and there were no symptoms of compression, I drew the scalp forwards and left the bone untouched, the patient making an excellent recovery, without any symptom of intracranial mischief. I am also acquainted with a gentleman upwards of fifty years of age, who has a depression in the parietal bone as large as the bowl of a table-spoon, the result of a fracture by a fall from a horse when a lad, and from which no inconvenience has resulted. I think, however, that this expectant practice should not be followed too implicitly, but that we must be guided by the circumstances of the particular case. If the depression be pretty uniform, of considerable depth, and occupy some extent of skull, which is depressed in a smooth hollow or bowl-like manner, and more especially if the patient be young and the scalp unwounded, it may be better doubtless to follow the practice of the above-named great surgeons, and to wait for symptoms of compression manifesting themselves before we interfere. If, however, the scalp be wounded, the depression be sharp, deep, and comparatively small in extent, we may reasonably suspect the existence of considerable splintering of the inner table; and here, I think, the safer plan would be, even in the absence of all symptoms of compression, to elevate

for the same reason that we trephine in punctured fracture—the prevention of inflammatory action that will be occasioned by the irritation of the splinters of the inner table. I would not, however, venture to dogmatise on this very important and difficult point of practice. The opinions of the most experienced surgeons are at variance; and cases may readily be adduced on either side in support of conflicting doctrines. It would appear that military surgeons generally are in favour of the expectant plan, and cases may be found in the works of Guthrie, Ballingall, &c., in support of this practice; and it is a remarkable circumstance, that in many of these instances in which recovery resulted in cases of depressed fracture of the skull which were not subjected to operative interference, the patients were exposed to great privations, possibly during a hurried retreat, and left in circumstances apparently the least favourable to recovery. So far as my own experience is concerned, which is necessarily drawn purely from civil practice, I can say that, with the exception of the case that has just been referred to, I do not recollect ever having seen a case recover in which a compound depressed fracture of the skull occurring in the adult has been left without operation; but I have, on the other hand, seen several instances of recovery in which the bone has been elevated, and fragments removed.

The sooner this is done the better. Danger does not arise from early operation, but from delay. The presence of depressed and spiculated fragments pressing into the dura mater must infallibly and speedily induce encephalitis. I have several times trephined under such circumstances as those with success, and have never had occasion to regret doing so. Indeed, there is no class of cases in which the operation of trephining is attended by such successful results as in those of depressed and comminuted fracture. Even though several days have elapsed and inflammation has set in, the proper treatment will be to remove the depressed and splintered bone, and thus give the patient his only chance—a slender one, it is true—of recovery. Under such adverse circumstances the patient may, however, be saved.

A man was admitted under Mr. Liston for a long depressed fracture on the side of the head, produced by the blow of a brickbat; though no sign of compression existed, yet symptoms of cerebral inflammation were speedily set up, and Mr. Liston trephined him on the fourth day after the accident; the man, who was perfectly conscious, walking into the operating theatre. A considerable splintering of the inner table was found, the fragments of which were removed. The dura mater having been punctured by one of the spicula of bone, diffuse suppuration of the membranes of the brain set in, and the patient died in a few days. In this case, however, the necessity for early trephining was clearly indicated, notwithstanding the absence of any symptoms of compression.

When a depressed fracture of the skull is complicated with a fracture or other injury of the spinal column, it is sometimes difficult to determine how much of the symptoms may be due to one accident, and what proportion to the other. In such a case as this, however, we should, I think, treat the depressed fracture irrespective of the vertebral injury, thus giving the patient a chance of recovery, of prolongation of life, or, at least, of return of consciousness before death. A man was admitted under my care into the hospital, with depressed fracture of the left parietal bone, and injury of the cervical spine, the precise nature of which could not be accurately determined. He was in a state of complete coma and paralysis. I trephined the skull and elevated the depressed portion of bone; he recovered his consciousness to a great degree, but died in a few days, apparently from the

injury to the spine. On examination after death, we found a fracture of the fifth cervical vertebra.

WOUNDS OF THE BRAIN AND ITS MEMBRANES.—Wounds of the brain and its membranes are frequent in injuries of the head, and constitute one of the most important complications of these accidents. The extent of injury inflicted upon the cerebral substance has wide limits, from slight laceration without exposure, to denudation of the brain, disintegration, and escape of large portions of its pulp.

Causes.—Injury to the brain may be occasioned in various ways. The simplest form is that, perhaps, which is not unfrequently met with in undepressed fracture of the skull, and sometimes happens without fracture, from simple concussion or commotion of the head; laceration of the cerebral substance occurring either under the seat of injury, or more frequently at a distant or opposite point, by a kind of *contrecoup*. This laceration of the brain by *contrecoup* is by no means of unfrequent occurrence. I have seen many striking instances of it, and have found it to be one of the commonest causes of death in simple fracture of the skull.

Laceration of the brain by *contrecoup* is attended by much extravasation of blood; and after death the brain-substance is found mixed up with coagula, and forming a soft, pulpy, bloody mass. In most instances that I have seen, the anterior lobes have been so contused, lacerated, and disorganised. This accident may occur without any fracture of the skull or external sign of serious injury, and usually results from falls upon the back or side of the head, often from an inconsiderable height, as when a person slips suddenly up in frosty weather and strikes his head on the pavement; the anterior portions of the hemispheres of the brain, or the parts opposite to that struck, will then be found in the condition just described.

The brain and its membranes are often lacerated by the *sharp spicula* of a depressed fracture, which may penetrate to a considerable depth in its substance. And, lastly, the injury may be occasioned by *foreign bodies*, such as bullets, traversing or lodging in the head; or by *stabs* and *punctures* through the thinner portions of the skull, especially the orbital plate of the frontal bone. In this way a piece of stick, tobacco-pipe, the point of a knife, or a scissor-blade, may puncture the anterior part of the brain.

Symptoms and Effects.—The symptoms and results of wound or laceration of the brain vary greatly according to the age of the patient, the seat of injury, and other conditions, which cannot very readily be determined. If the injury implicate those portions of the nervous centre at the base of the brain, the integrity of which is necessary for the proper maintenance of the respiratory act, immediate death must necessarily ensue. If, however, portions of this organ that are less essential to life, as the anterior lobes and upper part of the hemispheres, be injured, but very slight symptoms may occur; and in some cases there is no positive indication by which this injury of the cerebral substance can be determined, except by its exposure and escape through the external wound. Hence it is, that even the worst injuries of the head are rarely immediately fatal, the patient being seldom killed outright unless the medulla oblongata or pons be wounded. Children, especially, have been known to bear extensive injuries of the brain, and even the loss of a considerable quantity of cerebral matter, without any very serious effects, either immediate or remote; and it is by no means of uncommon occurrence to see them live several days with an extent of injury to the brain which would rapidly have proved fatal to an adult. Indeed it may be stated generally that, the younger the patient, the greater the chance of recovery. So, also, the prognosis may be considered more favourable after injury of the

brain in men of the labouring class, whose minds are but little exercised, than in persons of more cultivated intellect. Twitching of the muscles and epileptiform fits are commonly met with when the brain is lacerated; and these, complicating stertor, or alternating with it, indicate the nature of the mischief.

Foreign bodies even of large size and considerable weight have been lodged for a considerable time within the skull, in contact with the brain, without occasioning death. Thus Hennen states that he has seen five cases in which bullets were lodged within the skull, that did not prove immediately fatal. Dr Cunningham relates the case of a boy who lived for twenty-four days with the breech of a pistol, weighing nine drachms, lying on the tentorium, and resting against the occipital bone. Dr O'Callaghan has recorded the remarkable case of an officer who lived for about seven years with the breech of a fowling piece, weighing three ounces, lodged in the forehead; the right hemisphere of the brain resting on the flat part, from which it was only separated by false membrane.

From the great variety of effects produced by these injuries, it must be evident that there can be no one set of symptoms indicative of wound of the brain, provided there be no external wound through which the condition of the cerebral substance can be ascertained. In those cases in which this does not exist, we can at most only suspect laceration, if we find that the ordinary symptoms of compression or concussion are associated with signs that do not usually occur in those conditions when uncomplicated; such as contraction of one pupil, dilatation of the other, and perhaps an alternation of these states with twitchings of the limbs, hemiplegia of one side, or paralysis of an arm, and of the opposite leg, with perhaps involuntary spasmodic movements of the other members. These irregular symptoms, when accompanied by much coldness on the surface, slowness of pulse, and depression of vital power, may generally be looked upon as indicative of cerebral laceration.

Saccharine Diabetes is an occasional consequence of injuries of the brain. A man 43 years of age was admitted into hospital under my care with paralysis, the result of a fall on the back of his head. On examining his urine, it was found to contain sugar in very large quantity. Previously to the accident, he had been perfectly healthy and robust; and, as the paralytic symptoms disappeared, the diabetic sugar gradually lessened in quantity, until it ceased entirely to be formed, and this notwithstanding the continued use of saccharine and amylaceous matter in the food. M. Claude Bernard has recorded some similar instances in illustration of the more interesting and curious physiological fact pointed out by him, that wound of the central portion of the medulla oblongata and irritation of the fourth ventricle of the brain in rabbits occasions saccharine diabetes, and indeed, that in the dog artificial traumatic diabetes may be induced by fracture of the skull and consecutive injury of the brain.

Wounds of the brain may prove fatal, either at once, by the injury of the respiratory tract, in the course of a few hours, by the continuance of shock, and by the extravasation of blood within the cranium; at a later period, by the occurrence of encephalitis and its consequences; or more remotely still, by the supervention of paralysis and other ulterior effects of injury of the nervous system.

The *Cerebral Nerves* are occasionally torn across or detached from their connexion with the brain in injuries of the head. These nerves may be wounded by the same violence that injures the brain, as when a bullet traverses the head, or they may be detached from their connexion with the

brain in laceration of the cerebral pulp; or, lastly, they may be torn across in fractures of the base of the skull by the fissure extending across the foramen through which the nerve passes.

Any one of these nerves may be, and has been so injured, giving rise to paralysis of the part or organ supplied by it; but the one that most commonly suffers is the seventh, which, either in its facial or in its auditory portion, is not uncommonly torn across in fractures of the petrous portion of the temporal bone, producing either paralysis of the face or deafness.

Treatment.—In the treatment of injuries of the brain, little can be done after the system has rallied from the shock, beyond attention to strict antiphlogistic treatment, though this need not be of a very active kind. In these cases, indeed, as much should be left to nature as possible, the surgeon merely removing all sources of irritation and excitement from his patient, and applying simple local dressings.

If any foreign body be lodged within the skull, it must of course be removed, if possible. This may be done if it be situated near the external wound, or fixed in the bones; but if it have penetrated deeply into the substance of the brain, and have passed beyond the limits of the external wound as to have got completely out of reach, it would be perhaps more dangerous to trephine the skull on the chance of reaching it, or in any other way to go in search of it, than to leave it where it is. Bullets should always be extracted if they can be found. On this point military surgeons are agreed. If they enter the skull, and strike against and fracture the opposite side without escaping, should they be sought for? I think not. Larrey and Bell, it is true, have extracted the ball on the side of the head opposite the point of entrance. But it may not be found there. In a case of suicide to which I was called some years ago, a gentleman had shot himself through the right temple, immediately opposite the wound, on the left temple, was a raised, loose and stellate fracture of the skull, over which the scalp was uninjured. I cut down on this and removed the fragments of bone, expecting to find the ball beneath them; but in this I was disappointed, and after death the bullet was found lying in the base of the skull, where it had rolled.

FUNGUS OR HERNIA CEREBRI.—In those cases in which a laceration of the brain and dura mater communicates with a fracture of the skull, it is occasionally found, more particularly in children, that a dark brown or bloody fungous-looking mass of cerebral matter protrudes from the wound. The period after the receipt of an injury at which this protrusion takes place, varies from a few days—eight or ten—to several weeks. It has been remarked by Guthrie, and the observation has been fully confirmed, that hernia cerebri is more likely to take place through small than large apertures in the cranial bones. This tumour increases pretty rapidly, pulsates synchronously with the brain, and may shortly attain the size of a hen's egg, or even become larger. In its composition and structure it varies. In some instances it is composed chiefly, if not entirely, of extravasated blood; but the true fungus cerebri is composed of softened and disintegrated cerebral matter, infiltrated with lymph and blood. The softening of the brain, with red discoloration of its substance, extends for some little distance under the base of the tumour. The mental condition of the patient labouring under this affection is in many cases not much disturbed at first, there being merely some degree of cerebral irritation. Speedily, however, stupor comes on, and death eventually occurs from encephalitis, followed by coma, consequent on the inflammatory effusions that take place within the skull.

Treatment.—The treatment of this complication of fractures of the skull is commonly extremely unsatisfactory. If the tumour be shaved off, as usually recommended, it generally sprouts again until the patient is destroyed by irritation and coma conjoined. In some fortunate cases, however, the removal of the tumour is not followed by its reproduction. All that can be done is to slice off the growth on a level with the brain; to apply a pledget of wet lint, and a compress and bandage over the part, thus allowing it to granulate and the wound to cicatrize.

EXTRAVASATION OF BLOOD WITHIN THE SKULL commonly occurs in all injuries of the head accompanied by laceration of the brain, and in many of those in which the skull is fractured without that organ being injured. Indeed, when we reflect on the great vascularity of the parts within the skull, the large sinuses, the numerous arteries that ramify both within the bones and at the base of the brain, and the close vascular network extended over the surface of this organ, we can easily understand that extravasation of blood is one of the most frequent complications of these injuries and a common cause of death, when they terminate fatally at an early period after their occurrence.

Causes.—Intracranial extravasation of blood may take place either with or without fracture of the skull. When it occurs as the result of fracture, it is in consequence of the fissure tearing across one of the meningeal arteries distributed on the inside of the skull, or of a fragment of bone wounding a sinus or the vascular network on the surface of the brain; or it may proceed from laceration of this organ breaking down its capillary structure. In other cases again, as in gun-shot wounds, the hemorrhage may occur as a consequence of wound of the vessels by the bullet or other foreign body, but it may also be the result of apparently trivial injuries of the head without bruise or wound of scalp, or fracture of skull, from the rupture by concussion of one of the meningeal arteries.

Situations.—The extravasation may occur in four situations: 1. Between the dura mater and the skull, where it is most commonly met with; 2. Within the cavity of the arachnoid; 3. Upon the surface of the brain; or, 4. Within its substance and its ventricles. It is usually most considerable when poured out upon the dura mater, or within the cavity of the arachnoid at the base of the brain. It is in smallest quantity immediately on the surface of that organ, or within its substance. It is, however, seldom found in the latter situation as the result of violence, without being also met with more superficially. The quantity effused in any one case seldom exceeds four ounces; and, when in such large quantity as this, it usually proceeds from rupture of the meningeal artery.

Results.—Extravasation of blood is one of the most frequent causes of death in injuries of the head, by inducing pressure on the brain and coma. The blood that is extravasated usually conglutates into a firm granular clot. There can be no doubt, however, that extravasation of blood into the membranes of the brain frequently occurs without being attended by fatal consequences. The blood that is so extravasated may undergo various changes. It would appear that, 1. the extravasated blood may be absorbed entirely, 2. the serous portions and colouring matter may be removed, leaving a fibrinous buff coloured clot, which may eventually become organized; and 3. the exterior of the clot may become consolidated, whilst the interior contains fluid and disintegrated blood.

Symptoms.—The symptoms of extravasation are often by no means very clear, being those of compression, associated in the early stages of the case with symptoms indicative of laceration of the brain, and at a later period,

with those of encephalitis. Putting out of consideration, however, these complications, the more special symptoms of compression from extravasated blood may occur in two ways. In the first variety there are three distinct stages; viz., concussion, a return and some continuance of consciousness, and then coma gradually supervening. The patient is concussed or stunned as usual, after the receipt of a blow on the head; from this he quickly rallies, and then symptoms of compression set in, and gradually increase in intensity. He becomes drowsy and dull, with a slow and labouring pulse, dilated and sluggish pupils, and a tendency to slow respiration; as the compression increases, complete stupor at length comes on, with stertor in breathing, and there is either general paralysis, or hemiplegia of the side opposite to the seat of injury.

When the symptoms run this regular course, it is probable that the extravasation results from injury of one of the meningeal arteries or large venous sinuses; that the extravasation is confined to the membranes of the brain; and that there is no laceration of the substance of this organ. This may be termed the *meningeal extravasation*; it most commonly arises from rupture of the middle meningeal artery, which, from its situation in a deep canal in the parietal bone, is peculiarly apt to be torn in injuries of the side of the skull.

More commonly, however, it happens that the patient never recovers his consciousness after having been stunned, the symptoms of concussion speedily passing into those of compression. In these cases the paralysis is commonly incomplete, and is associated with twitchings of the limbs or convulsive movements of the body generally, and much restlessness with incoherent muttering: there is sometimes contraction, sometimes dilatation, of the pupils, and it occasionally happens that squinting is observed. It is especially when there are convulsions, that the pupils are observed to be in different conditions, and I have most frequently noticed the pupil dilated on the side that is most convulsed. In these cases the extravasation is probably connected with and dependent on, laceration or disorganisation of a portion of the brain, and may consequently be termed the *cerebral extravasation*.

Diagnosis.—The diagnosis of these two forms of extravasation from one another is important, as it is in the meningeal only that any operative procedure can be successfully undertaken; and it may usually readily be effected by attention to the symptoms just detailed.

The diagnosis of the compression from extravasation, and from depressed bone or inflammatory effusions within the skull, is easily made. In the case of the depressed fracture, we have symptoms of compression continuing uninterruptedly from the very first, and proper examination of the skull will always lead to the detection of the injured bone. When inflammatory effusions, whether of pus, lymph, or serum, exercise undue pressure upon the brain, we find that the signs of compression have been preceded by symptoms of cerebral inflammation, and that they are accompanied by a good deal of pyrexia, by quick pulse and hot skin; the character of the scalp-wound likewise, and the separation of the dura mater when pus is effused, enable us to distinguish this condition from those cases in which the pressure is the result of extravasated blood.

From *apoplexy*, the diagnosis is not always easily made, more particularly when there is no evidence that the head has been injured. A man was brought to University College Hospital in a state of profound coma, in which condition he had been found lying in the street. There was no evidence of injury about the head, beyond a bruise, which had probably been received when he fell. The case, which was supposed to be one of apoplexy, and

treated accordingly, proved fatal in a few hours. On examination after death the skull was found fractured, but not depressed. On the opposite side to the bruise and fracture, a coagulum, weighing nearly four ounces and compressing the brain, lay between the dura mater and bone. In such a case as this, it is evident that the history can alone afford a clue to its true nature. Even when the head has been injured, it is not always easy. A man was admitted under my care, comatose. A fortnight previously he had been struck on the left side of the head behind the ear. He was stunned, bled freely from the left ear, but then recovered tolerably, and went about his avocations as usual until the day before his admission, when he became suddenly comatose. There were stertor, quick pulse, and some heat of head; the right pupil was natural, the left contracted. He was treated antiphlogistically, but died on the third day. On examination, a fracture on the left side of the skull was found, extending into the left internal meatus; on the right side of the head, immediately opposite the fracture and the seat of injury, there was a large coagulum in the cavity of the arachnoid, with some serous exudation about it. Here was a meningeal extravasation, the result of *contrecoup*, existing without symptoms for fourteen days, and then proving rather suddenly fatal by the superveient of inflammation.

From the insensibility of drunkenness the coma resulting from injuries of the head may usually be distinguished by the absence of local mischief, by the smell of the breath, and by the face of the drunkard being flushed and turgid, and not pale as in a person who is suffering from the effects of a severe injury. When a drunken person has met with an injury of the head and is insensible, he should always be carefully watched, however slight the injury may appear to be, until sufficient time has elapsed for him to recover from his drunken fit; as it is impossible to say whether the stupor be the result of intoxication, or of mischief within the skull; and I have known cases to be sent away from hospitals as drunk, when in reality the stupor was occasioned by depressed bone.

In the stupor from poisoning by opium, the condition of the pupils, which are contracted to the size of a pin's point, instead of being widely dilated as in coma from cerebral compression, will enable the surgeon to make the diagnosis.

The Treatment of extravasation of blood may be conducted on two principles; either by means of general and local antiphlogistic measures, having for their object the arrest of further hemorrhage, the promotion of absorption, and the subduing of inflammatory action; or else by the application of the trephine, with the view of allowing the escape of the effused blood.

The line of treatment to be adopted should, I think, have reference to the character of the symptoms. When these indicate the cerebral form of extravasation, trephining can be of little service, and we must content ourselves with general antiphlogistics; but when the extravasation seems to be meningeal, then an attempt may be successfully made to evacuate the extravasated blood.

Although the operation of Trephining in cases of extravasation was formerly much in vogue, it is seldom had recourse to by modern surgeons, and is only proper in the meningeal form of extravasation. It is very true that, if it can be ascertained without doubt that the extravasation is not only of the meningeal character, but that it is so situated that the blood may be removed through the trephine-aperture, and if there be no other serious injury to the brain or skull, the operation should at once be performed. And doubtless the case occasionally happens in which, from the situation of the blow, and perhaps the presence of a capillary fissure over the course of the middle

meningeal artery, the gradual supervention of signs of compression after an interval of consciousness, and the occurrence of hemiplegia on the side opposite to that which has been struck, the surgeon is warranted in making an aperture in the skull at the seat of injury, in order to remove the blood that has been poured out, and to arrest its further effusion. But the instances in which this assemblage of symptoms could exist, with sufficient precision to justify an operation, are excessively rare. Out of some hundred cases of serious and fatal injury of the head that have been admitted into University College Hospital during the last twenty years, in three cases only, I believe, has it been found advisable to have recourse to trephining for the removal of extravasated blood. In two of these cases death speedily ensued, the coma being unrelieved by the operation. In the third case, recovery took place. The successful case to which I refer was that of a man admitted comatose, three days after receiving an injury of the head by a fall from a cab. There were no serious symptoms for some hours after the accident, but then stupor gradually came on, amounting at last to complete coma. On examination, a bruise of the scalp was found on the left temple: through this I made an incision, and, finding a starred fracture over the sinus of the middle meningeal artery, trephined the bone, when a large coagulum was found lying upon the dura mater, and, on removing this fluid, arterial blood freely welled up. The coma was relieved by the operation, and the patient made a good recovery. The most serious objection to the application of the trephine in cases of extravasation does not, however, consist so much in the difficulty of determining that blood has been effused within the skull, or that the extravasation is of the meningeal form, as in the difficulty of diagnosing that it is so seated between the dura mater and the skull as to admit of removal; not being effused at the base, nor so widely coagulated over the surface of the brain as to be unable to escape through the aperture that may be made. The likelihood of the co-existence of fracture of the base of the skull and of laceration of the brain, giving rise to the cerebral form of extravasation, must also be taken into account. For these various reasons, surgeons now very properly content themselves, in the great majority of cases of extravasation, with the employment of antiphlogistic treatment, on the principles already stated. With this view the head should be shaved, the ice-bladder applied, the patient bled, purged, and kept at perfect rest. If, however, the signs be urgent, and pretty clearly indicate the meningeal form of extravasation, and more especially if there be hemiplegia on the side opposed to that on which the blow has been received, with an injury in the course of the middle meningeal artery, the trephine may be applied at the seat of injury and the blood removed. It must be borne in mind that, however clear the signs, the extravasation may not be met with where the surgeon expects to find it. Under these circumstances, it is better not to prosecute the search by making fresh trephine apertures. In no case would a prudent surgeon trephine over the course of the middle meningeal artery in the absence of local symptoms, on the chance of finding the blood there, as has been recommended by some of the older surgeons.

OPERATION OF TREPHINING—Before concluding the subject of injuries of the head, it is necessary to say a few words on the operation of trephining, which, though far less commonly employed in the present day than heretofore, is one of sufficient frequency in practice, as well as of great importance from the serious nature of the cases that usually require it.

The trephine may be applied to the skull for two purposes; either with the view of preventing inflammation and its consequences, or for the purpose of removing some cause of compression. The only case in which procedure

trephining is practised by modern surgeons, is that of the punctured or starred fracture of the skull, without stupor; in all other instances in which it is called for, the object of its application is the removal of a cause of compression or of irritation of the brain, such as a depressed portion of bone, foreign bodies either fixed in the skull or lying close under it, and pus or blood extravasated within the cranial cavity.

The trephine should have a well-tempered crown, serrated half-way up its exterior, the teeth should be short and broad, and not too fine; the centre-pin must not project more than about the eighth of an inch, and care must be taken that the screw which fixes it is in good working order. The other instruments required are a Hey's saw, an elevator that will not readily snap, and a pair of strong dissecting-forceps.

The operation itself should be conducted in the following way. The head having been shaved, and the portion of the skull to which the trephine is to be applied having been freely exposed by means of a crucial or T-shaped incision, or by the enlargement of any wound that may exist, the trephine, with the centre-pin protruded and well screwed down, is to be firmly applied until its teeth touch the skull; it is then worked with rather a sharp, light, and quick movement, the pressure being exercised as the hand is carried from left to right. The centre-pin must be withdrawn so soon as a good groove is formed by the crown, lest it perforate the skull first and injure the dura mater. In this way the outer table of the skull is quickly divided, and the diploe cut into; the detritus which now rises by the crown of the trephine is soft and bloody, instead of being dry, as it is whilst the outer table is being sawn. As the instrument approaches the dura mater, the sawing must be conducted more warily, and must every now and then be interrupted, in order that the surgeon may examine with the flat end of a probe, or with a quill, the depth that has been obtained, care being taken that this is uniform throughout the circle. The surgeon now makes each turn very lightly, and now and then tries with a slight to-and-fro movement whether the circle of bone is loose. So soon as it is, he withdraws it in the crown of the trephine, or raises it out by means of the elevator. In this operation the dura mater must not be wounded; if it be injured, fatal consequences will probably ensue. The objects for which the trephining has been had recourse to must now be carried out, depressed bone being elevated or removed, and pus or blood evacuated. The scalp should then be laid down again, a few sutures and a piece of water-dressing being applied.

There are certain parts of the skull—over the venous sinuses, for instance, and near the base—to which no prudent surgeon would apply the instrument. No, also, if it were ever thought necessary to trephine at the frontal sinuses, the outer table must first be removed with a large crown, and the inner table sawn out with a smaller one.

After the operation, careful attention must be paid to antiphlogistic measures of a preventive and curative kind, the great direct danger to be apprehended being inflammation of the brain and its membranes. In some cases, also, there is reason to believe that suppurative phlebitis of the sinuses and tears of the diploe have been the cause of death.

The operation of trephining is by no means a favourable one in its results. Of 45 cases reported by Dr. Lente, as occurring at the New York Hospital in which, however, there is no distinction made between the application of the trephine proper and of various instruments, such as the elevator, Hey's saw, &c., belonging to a trephining case, only 11, or about one-fourth, recovered. Of 15 cases in which the trephine proper was used at University College Hospital, by Mr. Cooper, Mr. Liston, and myself, 5 patients recovered:

1 other died of injury of the spine unconnected with the operation, and the remaining 9 died from various causes.

The Parisian surgeons have not been very successful. Nélaton says that all the cases of injury of the head, 16 in number, in which the trephine has been used in the Parisian hospitals during the last fifteen years, have terminated fatally. But, although cases in which the trephine is used thus commonly terminate fatally, it would not be right to attribute the unfavourable result to the operation itself. In the majority of the cases death results from the injury sustained by the brain, from the pressure of extravasated blood at the base, or from encephalitis induced by the cerebral lesion, rather than from any direct influence exercised by the operation itself. And as the cases to which modern surgeons now restrict the use of the trephine would necessarily prove fatal if left to themselves, it is but right to give the patient the slender chance of one to four of escaping with life.

CHAPTER XXIII.

INJURIES OF THE SPINE.

INJURIES of the spine, like those of the head, derive their importance from the degree to which the enclosed nervous centre is implicated.

The spinal cord is subject to *Concussion*, *Compression*, and *Inflammation*, as the result of external violence; and any of these conditions may occur without injury to the osseous and ligamentous structures investing it, although, in the majority of cases, they are directly occasioned by fracture or dislocation of the vertebrae. It may also be *partially or completely divided* by cutting instruments, gun-shot wounds, or a broken vertebra.

CONCUSSION OF THE SPINAL CORD. — This may be occasioned in three distinct ways: 1, by severe blows on the spine, or by falls on the back, giving rise to local pain and signs of contusion; 2, by very slight injuries of or blows upon the spine; and, 3, by a general fall, jar, or concussion of the body without any evidence of a blow having been inflicted on the spine itself. These injuries have acquired a very considerable importance in late years, in consequence of having frequently become the ground of actions for damages against railway companies, by passengers who have suffered from the effects of collisions and other accidents on railways. And although some surgeons appear to doubt the possibility of the occurrence of concussion of the spine under the circumstances just mentioned, there can be no doubt that it may arise from simple falls, blows, or jars of the body, as every-day experience teaches. If this be conceded, it would indeed be somewhat remarkable that a railway carriage should be the only situation in which a person would, under all circumstances, be free from the possibility of the occurrence of this injury.

1. When the injury to the spine has been direct and severe, the symptoms are usually immediate and marked. The patient complains of pain at the part struck, is faint and concussed, unable to stand, and often has some relaxation of the sphincters. The persistence of these symptoms varies greatly. In the majority of cases, after a few days' rest in bed, with only cupping to the spine, or the abstraction of a few ounces of blood from the seat of injury, the symptoms will gradually subside, no ill consequences of the accident being left. In other cases, however, more or less con-

plete paraplegia, with impairment of the power of the sphincters, may be left for months, or even permanently. In such instances as these, the pathological condition giving rise to the paralysis of the parts below the seat of injury, will probably be found to consist of extravasation of blood into the spinal canal, or into the substance of the cord. In the *Treatment*, the best effects will be derived from counter-irritation by means of issues or blisters, the administration of small doses of the bichloride of mercury in lark, for a considerable length of time, and finally a course of the extract of *nux vomica*.

2. Concussion of the spine may be the result of *very slight, indeed of most trifling injury to the back*. When this is the case, the symptoms usually come on very slowly, not developing themselves with any marked degree of intensity until many weeks, possibly several months, have elapsed; and so obscure are they often at first, that the patient may not refer them to the injury he had previously sustained, and may indeed have entirely forgotten the occurrence until reminded of it by the questions of the surgeon. In such cases, the patient usually falls into a low cachectic state of health; he complains of weakness in the lower limbs, of an inability to stand long or to walk his usual distances; one foot possibly drags—he may be unable to support himself, or to hop on one leg; the sphincters also become affected; there is frequent desire to micturate, perhaps occasional involuntary escape of urine, flatus, or faeces; there are twitchings, more especially on falling to sleep, loss or perversion of the natural sensibility of the limbs, formations, neuralgic pains, and impairment or loss of sexual power. The lower extremities are usually most severely affected; but, in some instances, one or both arms may be the seat of the loss of innervation. These symptoms usually attain their maximum of intensity from six to twelve months after the receipt of the injury. They may continue permanently, or they may, under proper treatment, gradually lessen in severity; the patient seldom makes a complete recovery, but usually carries with him some evidence of loss or impairment of nervous power.

The pathological condition that directly occasions these symptoms, is probably softening of the cord from gradual impairment of its nutrition.

3. In a third class of cases, symptoms indicative of impaired innervation amounting even to paralysis, precisely similar to those just described, may arise from a *general jar or shock* of the body without the back being struck, or any violence being directly inflicted upon the spine itself. The spinal cord in these cases becomes concussed by the blow on a distant part of the body. Injuries of this description may arise from jumping from a great height, even though the patient have alighted on his feet; from falling heavily in the sitting posture; but more especially from being thrown violently forwards against the opposite side of the carriage in a railway collision. The latter class of cases especially are by no means of infrequent occurrence; and I have seen several well-marked examples of concussion of the spinal cord in this way. The carriage being brought to a sudden stop by the collision, the traveller's body, still carried forward at the speed with which the train was running, is violently dashed forwards against the opposite side of the vehicle. The shock to the nervous system is always very great in these cases—out of all proportion to the visible marks of external injury that the patient has received, and may very commonly lead to paralytic symptoms of a permanent character.

The effects of concussion of the spine that have just been described, whether arising from violence directly or indirectly applied, are occasionally slow in manifesting themselves to the full intensity; so slow, indeed, that

the patient may not connect their supervention with the injury which he had sustained some length of time previously. In some cases, it is important to observe that there is an interval of several weeks between the occurrence of the injury and the supervention of the symptoms of spinal mischief, during which time the patient makes no complaint of local suffering, and though his health may appear to be shaken and generally impaired, yet he is still able to follow his usual occupations; and it is not until loss of nervous power has declared itself in some of its usual forms, that the attention of the surgeon is called to the real nature and the full gravity of the injury sustained by the patient. Of this gradual supervention of symptoms of paralysis after concussion of the spine, which was long ago pointed out by Abercrombie and Sir C. Bell, I have seen several well marked instances. In one case a woman fell on the edge of a stair in the sitting posture, and several weeks elapsed before any symptoms of spinal mischief developed themselves. In another case a gentleman fell in the street on a frosty day, and, though only shaken at the time, gradually became paralysed after an interval of two or three months. In addition to these, I have in at least three or four instances witnessed the same slow supervention of symptoms after railway accidents. In these cases, the patient's health usually continued somewhat impaired for several weeks, or even months, after the accident. Symptoms of impaired innervation, formications, startings of the limbs, neuralgic pains, more or less paralysis of sensation or of motion, or of both, with perhaps diminution of power over the sphincters, then came on, which assumed usually a persistent character.

In the more chronic forms of the affection, *Traumatic Myelitis*, usually of a fatal character, is apt to come on. In these cases there is paralysis of the parts below the seat of injury, associated with pain and twitching of the muscles, the pain in the back being much increased on pressure.

Pathological Results.—After death in cases of concussion of the spinal cord, every condition is found between slight ecchymosis, with some redness of the membranes, through all the gradations of softening up to complete disorganisation of its structure. In many cases there is extravasation of blood into the substance of the cord itself. When this occurs, the clot is most commonly found in the grey substance, or, if not actually confined to this, at all events towards the centre of the cord and opposite the seat of injury. Occasionally blood is effused largely into the spinal canal, compressing the cord, and thus occasioning gradually increasing paraplegia. Sir A. Cooper mentions a case in which this happened as the result of a strain, the patient dying at about the end of a twelvemonth. When myelitis has occurred, the membranes are found congested and sloughy, and the cord itself in every degree of red softening up to complete liquefaction.

Treatment.—In the treatment of concussion of the spine, it is necessary to keep the patient in the recumbent position until the lower limbs have regained their power. The most convenient attitude for this purpose is upon the prone couch, which will be described when we come to speak of diseases of the spine. The patient should be cupped over the seat of injury, have his urine drawn off, his bowels opened by enemata, and his strength supported by a nourishing system of diet, which must be continued so long as the paralysis lasts. After a time, more especially if the bladder continue weak, blisters should be applied to the spine, and when merely a degree of debility is left in the lower limbs, the raw surface so produced may advantageously be sprinkled with strychnine properly diluted with starch.

WOUNDS OF THE SPINAL CORD may occur from stabs with pointed instruments, from gun-shot violence, or more frequently from the injury inflicted

upon it by the pressure of fractured vertebræ. In the latter form of injury there is an association of wound and compression, giving rise essentially to the same symptoms as if the cord were divided.

Symptoms.—When the spinal cord is *completely divided or compressed*, a certain set of symptoms occur that are common to all cases, at whatever part of the cord the injury has been inflicted, provided it be not so high up as to cause instant death.

In the first place, there is *complete paralysis of sense and motion* in all the parts below the seat of injury, though the mental manifestations continue intact. The precise seat of injury may often be diagnosed by the extent of the paralysis. Thus, in injury of the lower part of the spine, there may be paralysis of all those parts supplied by the nerves of the sacral plexus, whilst those from the lumbar are not affected; the sensibility being lost below the knees, whilst above it is perfect—thus leading to the inference that the injury has been inflicted above the one and below the other set of nerves. The *temperature of the part becomes lowered*; though in some cases, when the paralysis is not quite complete, the reverse has been observed; and after a time, a *visible diminution takes place in its nutritive activity*, the circulation becoming feeble with a tendency to congestion at depending points. This lessening of nutritive vigour is not, however, confined to the paralysed parts, but the whole of the system participates in it, the patient becoming speedily *anæmic and cachectic*. The skin assumes a dirty cadaverous hue, and the cuticle usually exfoliates in branny flakes.

These general symptoms of paralysis as the result of injury present important modifications according to the point at which the cord is divided; the line of paralysis rising in proportion as the injury to the cord is higher.

1. When the injury has been inflicted in the *Lumbar or Lower Dorsal Region*, there will be found to be complete paralysis of all the parts supplied by the nerves given off from the sacral or lumbar plexuses, or both; hence there will be paralysis of the lower extremities, of the genital organs, and of the trunk as high as the seat of injury. There is always in these cases relaxation of the sphincter ani, consequent incontinence of flatus, and, to a great extent, of feces. There is at first retention of urine in consequence of the paralysed state of the bladder, which is unable to expel its contents; after a time, however, the urine dribbles away as fast as it is poured into the overdistended organ, the neck of which has lost its contractile sphincter-like action. After the first few days the urine will be observed to be ammoniacal in odour, and alkaline in reaction. This is probably owing to changes that it undergoes after it has passed into the bladder, the mucous membrane of which becomes chronically inflamed, secreting a viscid alkaline mucus, which mixes with the urine. In the early stages of the accident, the penis will usually be observed to be in a state of semi-erection. Patients who have met with injuries of this portion of the spinal cord may live for many months, and even for a year or two, but eventually die, usually with sloughing of the bones, or from the supervention of some intercurrent visceral inflammation of a low type.

2. When the cord is divided in the *Upper Dorsal Region*, about the level of the third dorsal vertebra, we have not only the train of symptoms that have just been mentioned as characteristic of this injury lower down, but another set of symptoms is superadded to them, owing to the respiration being interfered with in consequence of the paralysis of the greater portion of the expiratory muscles. The intercostals, and those constituting the abdominal wall, no longer acting, imperfect expiration is solely effected by the elasticity of the walls of the chest; and those expiratory movements,

such as sneezing and coughing, which are of a muscular character, cannot be accomplished. In these cases it will be noticed that during inspiration, which is effected almost exclusively by the diaphragm, the ribs are depressed instead of being expanded and raised; and that the abdominal wall, which is soft and flaccid, is protruded far beyond its normal limits. In consequence of the impediment to respiration the blood is not properly arterialised, and a slow process of asphyxia goes on, usually running into congestive pneumonia, and terminating fatally in about a fortnight or three weeks.

3. When the injury is situated in the *Lower Cervical Vertebra*, not only do all the preceding symptoms occur, but there is paralysis of the upper extremities as well; and, the inspiration being entirely diaphragmatic, the circulation speedily becomes affected, the countenance assuming a suffused and purplish look. If the cord have been divided immediately above the brachial plexus, there will be complete paralysis of the whole of the upper extremities; but if the injury be opposite the sixth cervical vertebra, it may happen that they are only partially paralysed. This happened in two cases of fracture of the spine in this region that were some years ago under my care at the hospital. In both these instances the paralysis existed on the ulnar but not on the radial side of the arms, owing to the external cutaneous and radial nerves arising higher from the plexus than the ulnar, and thus just escaping injury. It is remarkable that, in both these cases, there was acute cutaneous sensibility in the arms along the whole line of junction between the paralysed and the sound parts. In cases of injury of the cord in this situation, death usually occurs by asphyxia in the course of a week.

4. When the division of the spinal cord takes place *above the Origin of the Phrenic Nerve*, opposite to or above the third cervical vertebra, instantaneous death results from the paralysis of the diaphragm, as well as of the rest of the respiratory muscles, inducing sudden asphyxia.

It occasionally happens in *partial division* of the cord, as in some cases of compression resulting from fracture, that the symptoms are not so clearly marked as in the instances that have just been recorded. Thus, for instance, the paralysis may not extend to all the parts below the seat of injury; it may be attended by severe pain in some of the semi-paralysed parts; or motion may be affected in one limb, and sensibility in another. These derivations from what is usual may generally be explained by some peculiarity in the seat of the injury to the cord, or by the extent of its division.

SPRAINS OF THE SPINE.—The *fibrous structures* that enter into the composition of the *spinal column* may be seriously injured without any concomitant primary lesion either of the bones or of the cord. These accidents usually happen as a consequence of violent and forcible twists of the spine by the body being doubled up at the time of the occurrence of the accident, or by an effort on the part of the sufferer to escape, by which he suddenly wrenches the body away from impending danger. As a consequence of this, the ligamentous and fibrous structures of the spine become strained, just as happens in the corresponding parts of a joint in an ordinary sprain.

The symptoms of this injury are as follows. The patient preserves a remarkably rigid and inflexible attitude; to maintain which, the lateral masses of spinal muscles are called into forcible action, and stand out in bold relief on each side of the vertebral column. He neither bends the body nor rotates the head freely, but prefers moving the trunk as a whole to rotating the spinal column. Any movement of the trunk or of the head, whether made by the patient himself or on him by the surgeon, gives rise to great suffering, more particularly if it be in a lateral or a rotatory direction.

the antero-posterior movements being better borne. There is often considerable tenderness on slight and very superficial pressure about the occiput, the cervical spine, and at other points along the vertebral column. These symptoms, which are of a very persistent and chronic character, may in some favourable cases, and under proper treatment, eventually pass off. But in the majority of cases the evidences of spinal irritation, which have in the first instance been confined to the spinal column, gradually extend to its centres; and symptoms indicative of subacute spinal meningitis, with disease of the cord and effusion into its sheath, gradually supervene. Loss of power over the sphincter ani and neck of the bladder, extinction of all sexual power, and even desire, formations, and other symptoms of altered nervous sensibility, as the sensation of a tightened cord being drawn round the trunk, occasional vomiting, and eventually paraplegia, will ensue. At the same time the patient gradually wastes, becomes anemic, cachectic, and may either die from the general breaking down of the powers of life, or by the induction of some specific local disease, as phthisis.

The Treatment of these serious cases should be conducted on the following principles:—1. Perfect rest of the body by confinement to the prone couch; 2. Repeated counterirritation along the whole length of the spine; 3. The administration of small doses of bichloride of mercury with bark, combined with good diet and pure air.

FRACTURE OF THE SPINE commonly results either from a direct blow upon the back, from a fall upon the head in such a way that the body is violently bent forwards, or from gun-shot injury.

The extent of the fracture and the amount of displacement necessarily vary greatly. The spinous process merely may be broken off; or the arch may be broken through on each side of the spine; or the fracture may extend through the body of the vertebra.

In some cases even of very extensive fracture there may be no appreciable displacement; but usually some change of position has ensued, and in many cases to such an extent as to compress or lacerate the spinal cord. The mode of occurrence of the fracture will influence the amount of displacement. If the fracture be through the arch, or consist in a simple detachment of the spinous process by a fall or a blow on the back, there may be little or no displacement. If it occur from gun-shot injury, or from a fall upon the head, or by forcible flexure of the neck and body forwards, as when the body is compressed between the top of a carriage and an archway, then there will probably be great displacement, and perhaps separation of the articulating surfaces of contiguous vertebrae.

The Signs of this injury vary very greatly, and will depend in a great extent upon the extent of the displacement. If this be inconsiderable, it may be extremely difficult, and even impossible in some instances, to pronounce with certainty whether the spine has been broken or not; the more so if the fracture do not implicate the body of the vertebra. If, on the other hand, the displacement be so considerable as to affect the axis of the column or to compress the cord, the symptoms are so marked as to admit of an easy diagnosis. They are of two kinds; those presented by the injury of the bone, and those dependent on injury by compression or laceration, or both, of the spinal cord.

The Local Signs are usually pain at the seat of injury, greatly increased on pressure or on moving the part; inequality of the line of the spinous processes, with depression of the upper portion of the spine, and corresponding prominence of the lower. There is an inability to support the body in the erect position, and to move the spine in any way; hence, when the upper

portion of the column is injured, the patient holds his head in a stiff and constrained attitude, fearing to turn it to either side.

The more *General Symptoms* of fracture of the spine are dependent upon the injury which the cord has received. If the fracture have not impaled the spinal canal, as when only the tip of a spinous process has been broken off, or if it be unattended by displacement, although it may traverse the body and arches, no symptoms depending upon injury of the cord need exist, and indeed occasionally they are absent. But even in these cases, there is usually some degree of paralysis, owing perhaps to the concussion to which the cord has been subjected at the moment of injury; and occasionally a sudden movement by the patient will bring on displacement, by which the cord is compressed and all the parts below the injured spot are paralysed. A woman was admitted into University College Hospital with an injury of the neck, the nature of which could not be accurately ascertained. She was in no way paralysed, but kept her head in a fixed position. A few days after admission, whilst making a movement in bed, by which she turned her head, she fell back dead. On examination, it was found that the spinous process of the fifth cervical vertebra had been broken off short, and was impacted in such a way between the arches of this and the fourth as to compress the cord. This impaction and consequent compression probably occurred at the time of the incautious movement, thus producing immediate death.

When there is only partial displacement of the fracture there may be but incomplete paralysis of the parts below the injury; of one arm, one leg, &c. In these cases there is usually great pain experienced at the seat of fracture, and extending from it along the line of junction between the paralysed and sound parts round the body or along the limb. This symptom, which is of great importance as exactly defining the seat of injury, is owing, as I found in a case of fracture of the sixth cervical vertebra under my care, to the fractured bone compressing and irritating the nerve that issues from the vertebral notch opposite the seat of injury.

In the majority of cases of fracture of the spine there is, however, such displacement of the bone as to compress the whole thickness of cord, and thus to occasion complete paralysis. In these cases, the symptoms are such as have been detailed in speaking of injuries of the spinal cord, on the compression, laceration, or division of which they are dependent.

Fractures of the spine through the bodies of the vertebrae are inevitably fatal, death ensuing in the two different ways, and at the different periods that have already been mentioned.

The *Treatment* of these injuries is sufficiently simple. No attempt at reduction can of course be made. All our efforts must be directed to the prolongation of life. With this view, if the fracture be in such a situation, at any point below the upper dorsal vertebrae, for instance, as will hold out a prospect of life being prolonged for a few weeks or months, means must be taken to prevent the occurrence of sloughing of the nates, an accident that is common, and usually of fatal termination, in these cases. The patient should therefore be laid at once on a water-bed, cushion, or mattress; he must be kept scrupulously clean, and his urine should be drawn off twice in the day at regular hours. If, as usually happens after a time, the bowels become confined, relief must be afforded by castor-oil or turpentine enemata. A nourishing diet must be administered, and perfect rest in one position enjoined. In this way life may be maintained for a considerable length of time; and it is probable that ossific union of the fracture may sometimes take place, though the patient may not recover from the paralysis, and will die eventually from disease of the cord.

In cases of fracture of the spine with depression of the arches, it has been proposed to trephine the injured bone, and elevate the fragment that has been driven in upon the cord. This operation, performed by Cline, Cooper, and Bell, was at first regarded with great favour and with sanguine expectation of benefit. It is now, I believe, generally abandoned by the best surgeons in this country, owing to its invariable, and, indeed, intrinsically fatal character.

DISLOCATIONS OF THE SPINE.—On looking at the arrangement of the articular surfaces of the vertebrae, the very limited motion of which they are susceptible, and the way in which they are closely knit together by strong ligaments and short and powerful muscles, it is obvious that dislocations of these bones must be excessively rare. So seldom, indeed, do they occur, that their existence has been denied by many surgeons. Yet there are a sufficient number of instances on record to prove incontestably that these accidents may happen. Those cases that have been met with have usually been associated with partial fracture, but this complication is not necessary. In all, the displacement was incomplete; and, indeed, a complete dislocation cannot occur.

Dislocation of the Atlas from the Occipital Bone has been described in two instances only—by Lassus and by Paletta. In the case by Lassus, death ensued in six hours, and the right vertebral artery was found to be ruptured. In the other case, the patient is said to have lived for five days, but the report is so incomplete that little value can be attached to it.

Dislocation of the Axis from the Atlas is of more frequent occurrence. It may happen with or without fracture of the odontoid process. In either case the axis is carried backwards and the spinal cord thus compressed. This accident is said to have been caused by a person in play lifting a child off the ground by its head; the combination of rotation and traction in this movement being especially dangerous, and liable to occasion the accident. For the same reasons, it has been met with in persons executed by hanging. Death would probably be instantaneous under these circumstances. It has, however, been stated that, in dislocations of this kind, life has been saved by the surgeon placing his knees against the patient's shoulders, and drawing or twisting the head into position. This, however, I cannot believe possible if the displacement have been complete; as death must be instantaneous, the cases of supposed dislocation and reduction having probably been instances of concussion of the cord with sprain of the neck.

Dislocation of any one of the five Lower Cervical Vertebrae may occur. The third vertebra is that which is least frequently dislocated; the fifth that which is more commonly displaced. These injuries are usually associated with fracture; but sometimes, though rarely, they happen without this complication. In these dislocations, as in those that have already been described, the displaced bone carries with it the whole of that portion of the vertebral column which is above it, no single bone being dislocated either among those above or those below the displacement.

These accidents most commonly happen from forcible flexion of the neck forward, though traction and rotation conjoined have occasioned them. In a case of luxation of the sixth and seventh cervical vertebrae, recorded by J. Roux, the accident happened to a sailor plunging into the sea for the purpose of bathing, and coming head foremost against a sail which had been spread out to prevent the attack of sharks; he died on the fourth day. In a patient of mine, who fell out of a window in such a way that the head was doubled forwards upon the chest, and who was brought to the hospital with supposed fracture of the spine, we found after death, which occurred on the

fifth day, that the seventh cervical vertebra, carrying with it the upper portion of the spine and the head, had been dislocated forwards from the first dorsal, there being a wide gap posteriorly between the laminae of these bones, with horizontal splitting of the intervertebral substance, detaching with it an extremely thin and small layer of bone from the body of the seventh. There was no fracture about the articular processes, which were completely separated from one another. The symptoms of this accident are necessarily excessively obscure, being very liable to be confounded with those of fracture. *Reduction* has been effected in a sufficient number of cases of this kind to justify the attempt being made when danger is imminent.

Dislocation of the Transverse Processes of the Cervical Vertebra occasionally occurs. In these cases the patient, after a sudden movement, or a fall on the head, feels much pain and stiffness in the neck, the head being fixed immovably, and turned to the opposite side to that on which the displacement has occurred. In these cases I have known *reduction* effected by the surgeon placing his knees against the patient's shoulders, drawing on the head, and then turning it into position, the return being effected with a distinct snap.

In the *Dorsal Region*, dislocation of the spine, though excessively rare, may occur; seldom, however, without being accompanied by some amount of fracture. The last dorsal vertebra has been several times found dislocated from the first lumbar, with rupture of the intervertebral fibro-cartilage. In these cases, however, there has usually been found fracture of the transverse processes of the first lumbar vertebra, or, as in an instance recorded by Sir C. Bell, fracture of its body.

I am not acquainted with any case in which dislocation of the *Lumbar* spine has been observed.

CHAPTER XXIV.

INJURIES OF THE FACE AND ADJACENT PARTS.

FACE.—Cuts about the *Cheeks and Forehead* are of common occurrence. These injuries present nothing peculiar, except that the structures of the face partake of the same tendency to ready repair, as well as to the supervention of erysipelatous inflammation, that characterises the scalp when injured.

In the *Treatment* of these wounds, it is of much consequence to leave as little scarring as possible. Hence the edges, after being well cleaned, should be brought neatly into apposition by fine hare-lip pins and twisted suture, or by a few points of interrupted suture; more particularly if they be in a transverse direction, and implicate the lips or nose. When they are in the neighbourhood of the eyelids, especial care must be taken to prevent any loss of substance, lest the contraction of the cicatrix produce eversion of the lid. In those cases in which a portion of the nose or lip has been lost, much may be done to repair the deformity by properly conducted plastic operations, such as will be described in Chapter lvii. The bleeding, which is usually very free in wounds of the face, in consequence of some arterial branch having been divided, may often be arrested by passing the hare-lip pin under the vessel, and applying the twisted suture above it, so that it may be compressed.

If the *Lip be cut from within*, by being struck against the teeth, the coronary artery may be divided, the patient swallowing the blood that flows into the mouth. Some years ago, a man was brought to the hospital, drunk, and

much bruised about the face. Shortly after his admission he vomited a large quantity of blood, which was at first supposed to proceed from some internal injury; but on examining his mouth, it was found that the blood came from the coronary artery of the lip, which was divided, together with the mucous membrane.

Parotid Duct.—It occasionally happens as the result of wounds or abscesses of the cheek that the parotid duct is divided, in consequence of which the wound does not close, and a trickling of saliva takes place upon the outside of the cheek, so as to establish a *Salivary Fistula*, a source of much disfigurement and inconvenience to the patient; the surface surrounding it being puckered and somewhat excoriated, and the fistula opening by a granulating aperture.

If this condition be recent, a cure may sometimes be accomplished, by paring the edges of the external wound, bringing them into close apposition, and applying pressure upon the part. If it be of old standing, the probability is that the aperture into the mouth is closed, and that something more will be required than bringing the lips of the wound together. To get it to close, we may adopt the plan recommended by Desaut, of passing a small seton from the mouth into the fistula, so as to make an artificial opening into the mouth, and then, when the course of the saliva has thus been established, closing the external wound. In order to make the internal artificial opening permanently fistulous, some surgeons have advantageously employed a red-hot wire.

Besides the fistula of the Stenonian duct, other fistulous apertures may take place in the cheek, as the result of injury or disease, allowing the escape of a small quantity of saliva. These openings are always difficult to heal—the edges becoming callous, and not readily taking on reparative action. Closure may be effected in some cases by canterisation with the nitrate of silver, or with a red-hot wire, due attention being paid to the general health. In other cases, again, the electric cautery may prove successful. If, however, the opening be free, with much indurated structure about it, the surgeon may find it necessary to excise a portion of the edges before bringing them together.

Foreign Bodies in the Nostrils, such as pebbles, beads, dried peas, &c., are occasionally met with in children, having been stuffed up in play, and becoming so firmly fixed as to require extraction by the surgeon. For this purpose a pair of urethral or polypus forceps will usually be found convenient. In some cases, however, a bent probe or an ear-scoop will remove the impacted body most easily.

The Ears are not unfrequently wounded in injuries of the head and scalp; a portion of the external ear being sometimes torn down and hanging over the side of the face. In these cases, as in scalp injuries, the part should never be removed, but, however lacerated and contused, should be cleaned and replaced by means of a few points of suture and strips of plaster. When the cartilaginous portion of the ear is divided, nice management is usually required in effecting perfect union.

Foreign Bodies are often pushed into the ears of children in play with one another. When pointed or angular, such as pieces of stick, they may readily be extracted with forceps; but when round and small, such as pebbles or beads, they are not so easily removed. Here the bent ear-scoop may occasionally be got round the body so as to remove it.

In some cases I have found an instrument, here represented (Fig. 142), and made by Coxeter on the model of Civiale's urethral scoop, useful in extracting a foreign body from the ear. It can be introduced straight and

then passed beyond it, when, by the action of a screw in the handle, the scoop is curved forwards, and so enables extraction to be readily effected. In other cases the foreign body is best removed by forcibly syringing the ear with tepid water, injected by means of a large brass syringe in a full stream, the pinna being drawn up so as to straighten the external meatus. In this way the bead or pebble is soon washed out by the reflux of the water striking against the tympanum. Should these means not suffice it is better to leave matters alone, and to allow the foreign body to become loosened, than to poke instruments into the ear with the view of forcibly extracting it. These attempts are ill-advised; and I have known death to follow prolonged and unsuccessful efforts at the extraction of a pebble from the ear.



Fig 142 - Ear-scoop

ORBIT.—Injuries of the orbit may be dangerous, either to the brain or to the eye. If deep and directed upwards, they are always serious, on account of the proximity of the brain, that it may happen that a pointed body, such as a piece of stick or a knife thrust into the orbit, fractures and perforates its superior wall, producing a fatal wound of the brain. The injury to the brain through the orbital plate of the frontal bone may be fatal by the consecutive inflammation that is induced; or the thrust may extend deeply, and, lacerating the internal carotid artery, occasion fatal hemorrhage. In one remarkable case recorded by Nelaton, a young man was wounded by the thrust of the point of an umbrella in the orbit; the cavernous sinus and internal carotid artery on the opposite side were wounded, an arterio-venous aneurism formed, the eyeball became prominent, and death by hemorrhage eventually resulted from the gangly way of the diffused arterio-venous aneurism. Occasionally inflammation is set up in the loose cellulo-adipose tissue contained in this cavity, giving rise to abscess, which may point in either eyelid; or, to inflammation extending itself to the encephalon. In other cases wounds of the orbit may be followed by loss of vision, without the eyeball being touched, either a consequence of injury of the optic nerve, or perhaps from the division of some of the other nerves of the orbit producing sympathetic amaurosis, as occasionally happens even from ordinary wounds of the face, implicating some of the terminal branches of the fifth pair.

EYE.—Injuries of the eyeball are so commonly followed by impairment or total loss of vision as to constitute a most important series of accidents: the delicacy of the structure of this organ being such, that slight wound of its more transparent parts, or displacement of the lens, is often followed by complete opacity and loss of sight.

Injuries of this organ may be divided into contusions and wounds.

Contusion of the Eyeball, without rupture or apparent injury of any of its structures, may give rise to such concussion of the retina as to be followed by temporary or permanent amaurosis. More frequently contusions of the eye are accompanied by extravasation of blood under the conjunctiva, and much ecchymosis of the eyelids. A "black-eye" is best treated by the continuous application of a weak arnica and spirit lotion.

Contusion of the Eye with Rupture of some of the Structures of the Ball is a most serious accident. The cornea may be ruptured, the humors lost, and vision permanently destroyed. Most frequently the rupture is internal, the outer tunics escaping all injury. In this case we may have an extravasation of blood into the eye, completely filling the anterior chamber, hiding and complicating deeper mischief within the ball. This condition, termed

hemophthalmia, is frequently associated with separation of the ciliary margin of the iris. In other cases, again, there may be displacement of the crystalline lens, which may be driven into the vitreous humor, be engaged in the pupillary aperture, or fall forwards into the anterior chamber. As a consequence of such injuries, the eye usually becomes inflamed, with intense frontal and circumorbital pain; disorganisation of the ball, and ultimately loss of vision, ensuing.

The *Treatment* of these injuries must always be of an active antiphlogistic character. Blood should be freely taken from the arm by venesection, and from the temple by cupping, the iris being dilated by the application to the eye of a solution of the sulphate of atropine, of the strength of two grains to an ounce of distilled water; the patient must be kept in a darkened room, on a strictly antiphlogistic regimen, and should be put under the influence of calomel and opium as speedily as possible. In this way the inflammation will be subdued, the effused blood absorbed, and perhaps vision restored. In some cases, however, opaque masses and bands of lymph will be deposited in the anterior chamber and the pupillary aperture, preventing more or less completely the entry of light. If the lens be displaced into the posterior chamber, it must be left there; if into the anterior, it may be extracted through the cornea.

Wounds of the Eyeball may be divided into those that are merely superficial, and do not penetrate into its chambers; and those that perforate its coats.

Non-penetrating Wounds are usually inflicted by splinters of iron, or other metallic bodies, which become fixed in the cornea, or between one of the eyelids and the ball. Very painful and troublesome injuries are sometimes inflicted by scratches of the eyeball with the nails of children.

In the *Treatment* of these superficial injuries, the first point is necessarily to remove any foreign body that is lodged. If it be fixed on the cornea, as commonly happens, it may be picked off with the point of a lancet or cataract needle; if it be a splinter of iron that has been so lodged, it is well to bear in mind that a small brown stain will be left after the metallic speculum has been taken off, this, however, will disappear in the course of a few days. In order to remove foreign bodies lodged between the ball and the eyelids, the latter must be everted so that the angle between the palpebral and ocular conjunctiva may be properly examined. For this purpose the lower eyelid need only be drawn down, whilst the patient is directed to look up; but the eversion of the upper eyelid requires some skill. It is best effected by laying a probe horizontally across it, immediately above the tarsal cartilage; the surgeon then taking the eyelashes and ciliary margin lightly between his finger and thumb, draws down the eyelid at the same time that he everts it by pressing the probe firmly backwards and downwards against the eyeball; the patient should then look down in order that the whole of the upper part of the conjunctiva, where the foreign body will probably be found, may be carefully examined.

Penetrating Wounds of the eyeball present great variety; they are commonly inflicted by bits of stick, steel pens, children's toys, and not unfrequently during the shooting season by the explosion of faulty percussion-caps or the lodgment of a stray shot in the eye. In all cases these accidents are highly dangerous to vision; and, when the foreign body lodges, sight is usually permanently lost.

The danger that ensues usually arises either from the eye being opened to such an extent that the humors escape, or else that, the iris becoming engaged in a wound in the cornea, a hernial prolapse of it occurs. The

remoter consequences usually arise from inflammation taking place within the globe, so as to produce an opaque cicatrix of the cornea or of the capsule of the lens; or else there is danger that adhesions may form, stretching across between the iris and the lens, or between these parts and the posterior surface of the cornea; or that inflammation may take place in all the structure of the ball, giving rise to disorganisation of it.

The *Treatment* of penetrating wounds is strictly antiphlogistic. Bleeding in the arm, cupping on the temples, low diet, a darkened room, and the administration of calomel and opium, are the principal points to be attended to. If the iris have protruded through a wound in the cornea, it should be carefully pushed back, and a drop or two of the solution of atropine put upon the eye. If it cannot be returned, it may be removed with a pair of fine curved scissors; and, at a later period, any staphylomatous tumour that may form should be touched repeatedly with a pointed piece of nitrate of silver. If there be a tendency to the formation of adhesions, or to the deposit of lymph within the pupil or the anterior chamber, our principal reliance should be upon small doses of calomel, in conjunction with opium. If the lens or its capsule have become opaque, traumatic cataract thus forming, extraction may be required at a later period of the case.

MOUTH.—Wounds of the mouth are seldom met with, except as the result of gun-shot violence. In these cases the amount of injury done to the soft structures, however great, is usually only secondary to the mischief that results to the brain, spinal cord, jaws, and skull, and must of course be treated on the ordinary principles of gun-shot and lacerated wounds.

TONGUE.—Wounds of the tongue usually occur from its tip or sides being caught between the teeth during an epileptic fit. They have been known to be inflicted purposely by insane patients, in attempts to excise this organ. Should the hemorrhage be free, the application of a ligature, or even of the actual cautery, may be needed to arrest it. These wounds generally assume a sloughy appearance for a few days; then clean up, and granulate healthily. It is useless to bring the edges together by sutures, which readily cut out. If, however, a large portion of the tip be nearly detached, it must be supported in this way; but the threads should be thick and passed deeply.

THE PALATE and the **PHARYNX** are sometimes lacerated by gun-shot injuries of the mouth; or the wound may result by something that the patient happened to have between his lips being driven forcibly backwards into his mouth. Thus, a tobacco-pipe may, by a blow on the face, be driven deeply into the substance of the tongue, or perhaps into the pharynx, wounding and lodging behind the arches of the palate, breaking off short, the fragment that is left in giving rise to abscess, to ulceration of the vessels, and perhaps to fatal secondary hemorrhage. In a case that was under my care some time ago, the soft palate was nearly completely detached from the palatal bones by a deep transverse wound, caused by the end of a spoon being forcibly driven into the mouth; good union took place eventually, the part having been stitched together by a few points of suture.

CHAPTER XXV.

INJURIES OF THE THROAT.

INJURIES OF THE LARYNX AND TRACHEA.

DISLOCATION AND FRACTURE OF THE LARYNX.—The cartilages of the larynx may be displaced, dislocated as it were, by violent blows; or they may be fractured, though but very rarely, the rupture in some cases taking place transversely, in others longitudinally. Digital examination of the part will at once detect the nature of the injury. In all these injuries there is danger of asphyxia, which indeed may be induced by simple concussion of the larynx. Should these symptoms be very urgent, tracheotomy may be required; if not, attention to position and support of the head will suffice.

WOUNDS OF THE THROAT.—These are of great frequency and importance, implicating as they do some of the most important organs in the body. They may be divided into three categories:—

1. Those that do not extend into the Air or Food-passages.
2. Those that implicate the Air-passages, with or without injury of the *Œsophagus*.
3. Those that are accompanied by injury of the Spinal Cord.

All these injuries are most commonly suicidal, and may be inflicted with every variety of cutting instrument; except where the spinal cord is injured, which must, in cases of suicide, be the result of gun-shot wound, and is necessarily fatal. Though incised, they are often jagged, and partake somewhat of the character of lacerated wounds, with great gaping of the edges.

1. *Wounds not extending into the Air or Food-passages.*—In these wounds, there is very commonly free and even fatal hemorrhage, and this sometimes though none of the larger arterial or venous trunks have been divided; the blood flowing abundantly from the venous plexuses and from the thyroid body. If the larger arteries be touched, as the carotid and its primary branches, the hemorrhage may be so abundant as to give rise to almost instantaneous death. Another source of danger in these cases proceeds from the admission of air into the veins of the so-called "dangerous region" of the neck. For this a free wound is by no means necessary, as is instanced by a remarkable case that occurred a few years ago near London, in which the introduction of a seton into the fore part of the neck was followed by death from this cause.

The large nerves, such as the vagus and phrenic, can scarcely, in a surgical wound, be divided without injury to the neighbouring vessels. The division, however, of the respiratory nerves on one side only, or even of one of them, would in all probability be fatal in man, by interfering with the proper performance of the respiratory act. In a case with which I am acquainted, where the phrenic nerve was divided during the operation of placing a ligature on the subclavian artery, death resulted in a few days from inflammatory congestion of the lungs.

In the *Treatment* of wounds of the neck of this category, the principal points to be attended to are, in the first place, the arrest of hemorrhage by the ligature of all bleeding vessels, whether arterial or venous; and, secondly,

bringing together the lips of the wound. If the cut be longitudinal, this may be done by strips of plaster; if transverse, by a few points of suture and by position, the head being fixed, with the chin almost touching the sternum, and retained in this posture by tapes passing from the nightcap to a piece of bandage fixed round the chest. I have had under my care one case in which, owing to the projection and mobility of the larynx, the wound did not unite, a large and deep gap being left, which required a series of plastic operations in order to effect its closure.

2. *Wounds implicating the Air-passages.* The air-passages are commonly wounded in suicidal attempts. They may be known to be opened by the air being heard and seen to bubble in and out of the wound during respiration. These wounds vary much in extent, from a small puncture with the point of a penknife to a cut extending completely across the throat, and even notching the vertebrae. They are frequently complicated with injuries of the larger vessels and nerves, and sometimes with wound of the *oesophagus*. Most commonly the cut is made high up in the neck; for the suicide, thinking that it is the opening into the air-passages that destroys life, draws the razor across that part of the throat where these are most prominent and easily reached; and thus, by not wounding the larger vessels, which are saved by the projection of the larynx, frequently fails in accomplishing his object.

There are four situations in which these wounds occur: above the Hyoid Bone; in the Thyro-hyoid Space; through the Larynx; and through the Trachea.

They may be made *above the Hyoid Bone*; the cut extending into the mouth and wounding the root of the tongue. When the wound is in this situation, it is usually attended with a good deal of hemorrhage; and there is much trouble in feeding the patient, as the power of swallowing is completely lost.

The wound may be inflicted in the *Thyro-hyoid Space*, laying the pharynx open, but being altogether above the larynx. This is the most common situation for suicidal attempts. In many cases, the incision is carried so low as to shave off or partly to detach the epiglottis and the folds of mucous membrane around it. In other cases, the edges of the glottis or the arytenoid cartilages are injured, the cut extending back to the bodies of the vertebrae. Here also there is great difficulty in swallowing, and great risk of the sudden supervention of oedema of the glottis, and consequent suffocation.

When the *Larynx* is wounded the incision is usually transverse; but I have seen a longitudinal cut made through the larynx, so as to split the thyroid and cricoid cartilages perpendicularly. In these cases of wounded larynx, there is much danger of the blood from the superficial parts trickling into the air passages and asphyxiating the patient, and of inflammation of the bronchi and lungs supervening at a later period.

Wounds of the *Trachea* are not so common as those of the larynx, from which they differ but little in the attendant dangers.

The *Oesophagus* is seldom wounded, as it can only be reached through the trachea by a deep cut, which will probably implicate the large vessels on one side or the other.

Effects.—There are various sources of danger in wounds of the neck implicating the air-passages. The hemorrhage, whether it proceed from any of the larger trunks, or consist of general oozing from a vascular surface, may either prove directly fatal by the loss of blood, or indirectly so in consequence of the blood trickling into the air-tube, and, by accumulating in its smaller divisions, producing suffocation.

Another source of danger in some of these cases arises from the supervention of *asphyxia*, either in the way that has already been mentioned, or, in those cases in which the wound has been inflicted above the larynx, from the occurrence of oedema of the glottis. This condition may likewise occur in those cases in which the external opening is very small, and occasionally happens suddenly when the wound has nearly closed.

Another source of danger is the *loss of the natural sensibility of the glottis*, in consequence of which it no longer contracts on the application of a stimulus. Hence food taken in by the mouth may pass into the larynx and make its appearance in the external wound, even though neither the pharynx nor the oesophagus have been wounded. This I have observed in many cases of cut-throat; hence the presence of food in the wound cannot in all cases be considered an evidence of injury to the food-passages. This occurrence is always a bad sign, and is never met with in the earlier periods of the injury; never, indeed, until a semi-asphyxial condition has come on, by which the nervous sensibilities are blunted, or until inflammation has been set up about the rima glottidis, giving rise to so much swelling as to interfere with the natural actions, and to deaden the perception of the part to the contact of a foreign body. In these cases also it will be found that the sensibility of the air-passages generally is much lowered, so that mucus accumulates in the bronchi, even to a dangerous extent, the patient not feeling the necessity for expectoration, and often, indeed, having much difficulty in emptying his chest.

The occurrence of *bronchitis* and *pneumonia*, either from the inflammation extending downwards from the wound, or in consequence of the cold air entering the lungs directly, without being warmed by passing through the nasal cavities, is perhaps the most serious complication that can happen in these injuries, and constitutes a frequent source of death in those patients who survive the immediate effects of the wound.

The *depressed mental condition* of the patient also is usually unfavourable to recovery in all those instances in which the wound is suicidal, disposing him to the occurrence of low forms of inflammatory mischief.

Treatment.—We have already considered the management of those wounds of the throat that do not interest the mucous canals in this region. When these are opened, the same general principles are required as in the former case. Hemorrhage must be arrested by the ligature of all the bleeding vessels, whether arteries or veins, so that no oozing or trickling into the wound may take place.

In some cases the hemorrhage consists principally of general venous oozing which cannot be stopped by ligature, the patient drawing a large quantity of blood into the air passages through the wound in them. Under these circumstances, I have found it useful to introduce a large silver tube into the aperture in the windpipe, and to plug the wound around it. So soon as the bleeding has fairly ceased, the plugs and the tube must be removed.

The edges must next be brought together by a few stitches introduced at the sides, and by attention to position, the head being fixed by tapes as already described in the former section. I think, with Liston, that in these cases the wound should never be closely sewed up, nor stitches introduced into the centre of the cut. If the centre of the integuments be closely drawn together, coagula may accumulate behind them, in the deeper parts of the wound, so as to occasion a risk of suffocation; and, as this must eventually clear by granulation, no material advantage can possibly be gained by this practice.

There is an exception, however, to this rule of not using stitches in the

central part of the wound in cut-throat; viz., in those cases in which the trachea has been completely cut across. Here a stitch or two on each side of the tube is necessary, in order to prevent the wide separation of the two portions that would otherwise take place, owing to the great mobility of the larynx and upper end of the windpipe.

In order to lessen the liability to inflammation of the lungs, the patient should be put into a room, the temperature of which is raised to about 80° Fahr., with a piece of lightly folded muslin acting as a respirator laid over the wound. So soon as the cut surfaces begin to granulate, water-dressing may be applied, and the edge of the wound brought into apposition by strips of plaster, and a compress if necessary. During the treatment, the principal danger proceeds from inflammatory affections of the chest; these must accordingly be counteracted by the temperature in which the patient is placed, and by as active antiphlogistic remedies as his condition will admit of. It must, however, be remembered that the mental depression, and the bodily exhaustion from loss of blood, that are commonly met with in these cases, do not allow a very active course of treatment to be pursued.

The *administration of food* in these cases is always a matter requiring much attention. As a general rule, the patient should be kept on a nourishing diet, with a moderate allowance of stimulants. If, as not uncommonly happens, the food passages are opened in consequence of the wound extending into the mouth, the pharynx, the œsophagus, it is of course impossible for the patient to swallow, and the administration of nourishment becomes a source of considerable difficulty. This is best accomplished by means of an elastic gum catheter passed through the mouth into the gullet or stomach. This is easier than passing the instrument through the nose, and much better than introducing it through the wound. In this way a pint or more of the strongest beef-ten, ox-tail soup, or Laëbig's "*Liquor Carnis*," which I have used with advantage, mixed with two or three eggs, and having an ounce or two of brandy added to it, should be injected regularly night and morning, until the patient is able to swallow. In those cases in which the wound is above the larynx, there is occasional danger of the supervention of œdema of the glottis; should this occur, tracheotomy may become necessary in order to prolong the patient's life.

As consequences of wounds of the throat we occasionally find stricture of the trachea, or aerial fistula. If the chordæ vocales happen to have been injured, loss of voice may result.

AERIAL FISTULA may sometimes form, owing to the skin doubling in and becoming adherent to the edges of the wound in the air-tube, and most frequently occurs when the cut is in the thyro-hyoid space; adhesion taking place between the integuments, which are doubled in, and the œ hyoides above and the surface of the thyroid cartilage below. The same will happen in the crico-thyroid space, and may indeed occur at any part of the larynx that has been opened. When this happens, there is a tendency to the fistula continuing patent. Under these circumstances, I have found the following operation successful in closing it.

The edges of the fistulous opening having been freely pared, and the knife passed under them for some distance so as to detach them from the subjacent parts, a vertical incision is made through the lower lip of the opening—so as to split it downwards. Two points of suture are then inserted into each side of the horizontal incisions, bringing their edges into contact, *but the vertical cut is left free for discharges and mucus to drain through, and for the expired air to escape, lest emphysema occur.* Unless this outlet be afforded, these fluids will burst through the sutures, and thus destroy union of the edges.

It is not in every case that an aërial fistula can be safely closed. In some instances the larynx becomes contracted either by drawing in of the wound, or by thickening of the mucous membrane above the artificial opening to such an extent that the fistula becomes essential, in addition to the orifice of the glottis, for the purposes of respiration. Under such circumstances, any attempt at closing it will be attended or followed by symptoms of impending asphyxia or collapse of the lungs; and it may be necessary to leave the opening free, or even, as happened in a case lately under my care, in which an opening was left in the crico-thyroid membrane of a girl who had attempted suicide by cutting her throat, to enlarge the opening and to introduce a silver tube in order to relieve the breathing from the effects of the laryngeal constriction.

FOREIGN BODIES IN THE AIR-PASSAGES.—Though the introduction of foreign bodies into the air-passages is not a very common accident, yet a great variety of substances that admit of being swallowed have been found there: such as nut-shells, beans, cherry-stones, teeth, meat, money, buttons, pins, fish bones, bullets, pills, pebbles, and pieces of stick. These foreign bodies are not introduced into the air-passages by any effort of deglutition, for no substance can be *swallowed* through the glottis; but they are *inhaled*; thus if a person, whilst holding any substance in his mouth, make a sudden inspiration, the current of air may draw it between the dilated lips of the glottis into the larynx.

The *Symptoms* vary, according to the situation in which the foreign body is lodged, its nature, and the period that has elapsed since the occurrence of the accident. The foreign body may lodge in one of the ventricles of the larynx, or, if light, it may float in the trachea, carried up and down by the movement of the air in expiration and inspiration. If too heavy for this, it will fall into one or other of the primary divisions of the trachea, and, as Aston Key has observed, will most commonly be found in the right bronchus, this being larger, and in a more direct line with the trachea than the left. If the substance be small, it may pass into one of the secondary divisions of the bronchi; and, if it continue to be lodged here for a sufficient length of time, may make a kind of cavity for itself in the substance of the lung, where it may either lie in an abscess, or become encysted.

The symptoms may be divided into three stages: 1. Those of Obstruction, immediately following the introduction of the substance; 2. Those of Irritation, produced by its presence; and 3. Those of Inflammation, coming on at a later period.

1. *Symptoms of Obstruction.*—The immediate symptoms vary somewhat, according to the size and nature of the body, and the part of the air-tube that it reaches. In all cases there is a feeling of intense suffocation, with great difficulty of breathing, and violent fits of spasmodic coughing, often attended by vomiting; during which the foreign body may be expelled. Indeed, its partial entry and immediate extrusion, by coughing, are not uncommon. In some cases, immediate death may ensue at this period. If the body have entered the air-passages fully, there is usually violent coughing with feeling of suffocation for an hour or two, accompanied by lividity of the face, great anxiety, and sense of impending death. There is also usually pain felt about the episternal notch. These symptoms then gradually subside, but any movement on the part of the patient brings them on again with renewed violence. All these symptoms are most severe if the foreign body remain in the larynx; the voice being then croupy, irregular in tone, or lost. If it be lodged elsewhere, so often as it is coughed up, and strikes against the interior of the larynx, an intense feeling of suffocation is pro-

duced; and if it happen to become impacted there, sudden death may result, even though it be not of sufficient size to block up the air-passages, apparently by the spasm that is induced. Some years ago a boy died at the Westminster Hospital before tracheotomy could be performed, in consequence of a flat piece of walnut-shell that had entered the trachea being suddenly coughed up, and becoming impacted in one of the ventricles of the larynx. The symptoms, during this period, are much less severe when the foreign body is in the trachea or bronchi.

2. *Symptoms of Irritation.*—When the foreign body has passed into the air-passages, and the immediate effects produced by its introduction have been got over, another set of symptoms, dependent on the irritation produced by it, is met with; and it is during the occurrence of these that the patient is most generally brought under the surgeon's observations. These symptoms are of two kinds; *general* and *auscultatory*.

The *General Symptoms* consist of occasional fits of spasmodic cough, accompanied by much difficulty of breathing, a feeling of suffocation, and an appearance of urgent distress in the countenance. These attacks do not occur when the patient is tranquil, but come on whenever the foreign body is coughed up so as to strike the larynx, and the upper and more sensitive parts of the air-passages. As a general rule, the distress is less, the lower the substance is lodged; the sensibility of the inferior portion of the trachea and bronchi being much less acute than that of the larynx and the upper part of the trachea. In consequence of the irritation, there is usually abundant expectoration of frothy mucus. These symptoms often remit for a time, more particularly if the foreign body become fixed. In some cases, indeed, there appears to be so little distress some days after the accident, that considerable doubt may exist in the mind of the surgeon, whether any foreign body really be lodged in the air-passages or lungs; and much valuable time is often lost by his indisposition to adopt active measures when the symptoms are not urgent.

The *Auscultatory Signs* depend necessarily upon the situation of the foreign body. If this be loose and floating, it may be heard, on applying the ear to the chest, moving up and down, and occasionally striking against the side of the trachea. If it be fixed, it will necessarily give rise to a certain degree of obstruction to the admission of the air beyond it, perhaps occasioning *bruits* during its passage. If it be impacted in the larynx, the voice will be hoarse and croupy, and there will be a loud rough sound in respiration, with much spasmodic cough and distress in breathing. If it be impacted in one bronchus, the respiratory murmur will be much diminished, or even absent, in the corresponding lung, and probably puerile in the other; whilst percussion will yield an equally clear and sonorous sound on both sides of the chest, air being contained in the lung of the obstructed side, but not readily passing in and out. If one of the subdivisions of either bronchus be occupied by the foreign body, the entrance of air will be prevented in the corresponding lobe of that lung, though it enter freely every other part of the chest. If the foreign body be angular, or perforated, peculiar sibilant and whistling noises may be heard as the air passes over and through it.

3. *Inflammation*—After a foreign body has been lodged for a day or two, symptoms of inflammation of the bronchi or lungs are apt to be set up, in some cases, however, these only occur after a considerable time has elapsed, or, perhaps, not at all, much depending, of course, on the shape and character of the irritant. If it continue to lodge, it generally forms for itself a cavity in the substance of the lung, whence purulent and bloody

matters are continually expectorated, until the patient dies in the course of a few months, or a year or two, of phthisis. It has occasionally happened, however, that the substance has been coughed up after a very long lodgment, the patient recovering. Thus, Tulpus relates a case in which a nut-shell was coughed up after being lodged for seven years; and Heckster one in which a ducat was thus brought up after a lapse of two years and a half; the patients, in both instances, recovering. In other cases death may ensue, although the foreign body is coughed up; thus Sue relates an instance in which a pigeon-bone was spat up seventeen years after its introduction, the patient, however, dying in little more than a year from marasmus.

Prognosis.—This depends more upon the nature of the foreign body and its size than on any other circumstances. If it be rough, angular, and hard, there is necessarily much more risk than if it be soluble in, or capable of disintegration by, the mucus of the air-passages. So long as the foreign body is allowed to remain in, the patient is in imminent danger, either from immediate and sudden suffocation, or from inflammation at a more remote period.

The danger depends greatly upon the length of time during which the body is allowed to lodge. Of 62 cases (4 of which have fallen under my own observation, the remaining 58 being collected from various sources, and constituting all those that I have been able to find recorded) I find the time that the foreign body was allowed to remain in, and the result of the case stated in 49 instances, which I have here tabulated:—

PERIOD THAT IT REMAINED IN.	NUMBER OF CASES	RECOVERED	DIED
Less than 24 hours	8	6	2
Between 24 and 48 hours	4	3	1
Between 48 hours and 1 week	13	6	7
Between 1 week and 1 month	8	4	4
Between 1 month and 3 months	3	3	0
Between 3 months and 1 year	6	4	2
More than 1 year	7	4	3
Total	49	30	19

From this it would appear that, if the patient escaped the danger of the immediate introduction, the greatest risk occurred between the second day and the end of the first month, no fewer than 11 patients out of 21 dying during this period; and then that the mortality diminished until the third month, from which time it increased again.

The cause of death also varies according to the period at which the fatal result takes place. During the first twenty-four, and, indeed, forty-eight hours, it happens from convulsions and sudden asphyxia. During the first few weeks it is apt to occur from inflammatory mischief within the chest; and after some months have elapsed the patient will be carried off by marasmus or phthisis.

Spontaneous expulsion of the foreign body, usually in a violent fit of coughing, occasionally occurs. Dr. Gross finds that there are 49 cases on record, in which the body was spontaneously expelled, the patient recovering. Of these, in 37 it was expelled during a fit of coughing. The period during which a foreign substance may remain in the air-passages before it is spontaneously expelled, varies from a few minutes to many months or years, in

one case, a piece of bone introduced at the age of three, was not ejected until sixty years had elapsed. In 8 cases death followed the spontaneous expulsion.

Treatment.—This accident is always a very serious one, and hence requires prompt and energetic means to be used in order to save the patient, and fortunately the means at our disposal, consisting of the simple operation of opening the trachea, and thus facilitating the expulsion of the foreign body, are usually highly successful. I find that of 60 cases in which the result was noted, 37 lived, and 23 died; but on analysing these cases more closely, it appeared that in 39 no operation was performed; the expulsion of the foreign body being trusted to the efforts of nature. Of these 23 died, and 16 lived. In the remaining 21 cases, tabulated below, tracheotomy was performed; of these 18 lived, and only 3 died, showing a remarkable success attendant on this operation.

PERIOD THAT IT REMAINED IN.	NUMBER OF CASES.	CURED.	DIED.
Less than 24 hours	1	2	1
Between 24 and 48 hours	2	2	0
Between 48 hours and 1 week . .	9	8	1
Between 1 week and 1 month . . .	5	4	1
Between 1 and 3 months	2	2	0
Total	21	18	3

Dr. Gross has also given extensive statistics of the removal of foreign bodies, and has found that out of 68 recorded cases in which *tracheotomy* has been performed, the operation was successful in 60, and in 8 the patient died. In some cases *laryngotomy* has been performed instead of *tracheotomy*, and the foreign body has been equally well expelled. Dr. Gross gives 13 instances of this, successful in their results, to 4 in which death followed the operation. *Laryngo-tracheotomy* was done in 13 cases; of these there were 10 successes, and 3 deaths.

Dr. Gross's statistics of 160 cases are as follows :—

	RECOVERED.	DIED.	TOTAL.
Spontaneous expulsion	49	8	57
Inversion of body alone	5	0	5
Tracheotomy	60	8	68
Laryngotomy	13	4	17
Laryngo-tracheotomy	10	3	13

Emetics, sternutatories, and succussion of the body, are all either useless or dangerous. Inversion of the body has succeeded in several instances, and might, I think, be tried before operation is had recourse to, more particularly if the foreign body be a coin, and is moveable in the air-passages. Mr. Padley caused the ejection of a sixpenny-piece in this way from the trachea of a man, and he recommends the supine as a safer and better position than the prone. There is undoubtedly danger, in inversion, of the supervention of laryngeal spasm, but statistics do not prove that any fatal consequences have resulted from this cause. Should, however, the attempt at expulsion by inversion of the body bring on an attack of laryngeal

spasm, the attempt should be abandoned as not only useless but in the highest degree dangerous, until the windpipe has been opened.

Operation.—If, therefore, a patient be seen a few hours, days, or weeks, after a foreign body has been introduced into the air-passages, or indeed at any period after the accident, and inversion has failed, tracheotomy ought to be performed. And this should be done, even though the symptoms be not urgent. There is often a remission in the symptoms, a lull, a period of deceptive security, by which the surgeon must not be put off his guard, but proceed without delay to tracheotomy. But, it may be asked, for what purpose is the trachea opened? Why should not the foreign body be expelled through the same aperture by which it has entered? The opening in the trachea performs a double purpose; it not only serves as a ready and passive outlet for the expulsion of the foreign body, but also as a second breathing aperture in the event of its escaping through the glottis. The advantage of the opening in the trachea as a ready aperture of expulsion is evident, from the fact that, of 14 of the operated cases in which it is stated how the foreign body was expelled, I find that in 12 it was ejected through the artificial opening, whilst in 2 only did it pass out through the glottis.

The reason why the foreign body usually passes out of the artificial opening in preference to escaping by the glottis, is, that the sides of the former aperture are passive, whereas those of the latter are highly sensitive and contractile. Before the operation is performed, it will be found that the great obstacle to expulsion is not only the sensitiveness of the larynx, great irritation being induced when it is touched from within, but also the contraction of the glottis, by the closure of which not only is the expulsion of the foreign body prevented, but respiration is impeded. Every time the foreign body is coughed up so as to touch the interior of the larynx, intense dyspnoea is produced, owing to sudden and involuntary closure of the glottis, by which respiration is entirely prevented and suffocation threatened; the expulsion of the body is consequently arrested, unless it were by chance to take the glottis by surprise, and pass through it at once in the same way that it has entered it, without touching its sides. If there be a second breathing aperture, though the larynx is equally irritated by the foreign body, yet this dyspnoea cannot occur, respiration being carried on uninterruptedly by one opening whilst the foreign body escapes through the other; and thus, under these circumstances, it may pass through the glottis with but little inconvenience to the patient.

In some cases, the foreign body is expelled at once after the trachea has been opened; in others, not until some hours, days, or even weeks, have elapsed. Thus, in Houston's case, a piece of stick was not coughed up until ninety-seven days after the operation; and in Brodie's case, sixteen days elapsed before the half-sovereign came away.

The expulsion has in some instances been facilitated by inverting the patient, shaking him, or striking him on the back. In cases in which the foreign body is not readily expelled, it has been proposed to introduce forceps and extract it. But, although in some instances this has succeeded, the uncertainty and danger of such a proceeding are so great that few surgeons will be disposed to attempt it; the introduction of the forceps producing violent irritating cough, during which their points might readily be driven through the bronchi, and thus wound the lung or contiguous important structures. Besides this, there would be the danger of seizing the projecting angle at the bifurcation of the bronchi instead of the foreign body, and thus wounding the parts seriously. If the foreign body be fixed, the safer plan

will certainly be to leave the aperture in the trachea unclosed, and wait for the loosening of the body and its ultimate expulsion, which have hitherto occurred in all cases that have been operated on; or its escape might be facilitated by the gentle introduction of a probe, so as to dislodge it if seated in either bronchus, though this should be done with great caution, or the patient may be inverted and succussed, when the expulsion may take place. Should it not then escape, the wound should be kept open by means of blunt hooks, when, perhaps, it may be ejected.

Antiphlogistic treatment must be continued during the whole progress of the case. After the escape of the foreign body, the opening in the trachea must be closed.

SCALDS OF THE MOUTH, THE PHARYNX, AND THE GLOTTIS, occasionally occur from attempts to swallow boiling water; or these parts are scorched by the inhalation of flame. The scalding of these parts chiefly happens to the children of the poor, who, being in the habit of drinking cold water from the spout of a kettle, inadvertently attempt to take a draught from the same source when the water is boiling. The hot liquid is not swallowed, but though immediately ejected, has scalded the inside of the mouth and pharynx, giving rise to a considerable degree of inflammation, which, extending to the glottis, may produce cedema of it, and thus speedily destroy life by suffocation. In three cases which I have had an opportunity of examining after death, there was no sign of inflammation below the glottis, though the lips of the aperture were greatly swollen; and this I believe to be invariably the case, the inflammation not extending into the interior of the larynx, as has been pointed out by Dr. M. Hall.

The accident always reveals itself by very evident signs; the interior of the mouth looks white and scalded, the child complains of great pain, and difficulty of breathing soon sets in; which, unless efficiently relieved, may terminate in speedy suffocation.

In those cases in which these parts have been similarly injured by the flame produced by the explosion of gas or of fire-damp being sucked into the mouth, the same conditions present themselves.

In the *Treatment* of this injury, the main point to attend to is to subdue the inflammation before it involves the glottis to a dangerous extent. With this view, leeches should be freely applied to the neck, and calomel with antimony administered. If symptoms of urgent dyspnoea have set in, tracheotomy must be performed without delay; and, if the child be not too young, a tube must be introduced into the aperture so made, and kept there until the swelling about the glottis has been subdued by a continuance of the antiphlogistic treatment. In the majority of the cases, however, that have fallen under my observation, in which this operation has been performed, the issue has been a fatal one, from the speedy supervention of broncho-pneumonia; but as it affords the only chance of life when the dyspnoea is urgent, it must be done, though its performance in very young children is often attended by much difficulty, from the shortness of the neck and the small size of the trachea.

ASPHYXIA.

THE SURGICAL TREATMENT OF ASPHYXIA includes the management of those cases in which respiration has been suspended by Drowning, Suffocation, Hanging, or the Inhalation of Irrespirable Gases. The general subject of suspended animation from these various causes cannot be discussed here, but we must briefly consider some points of practical importance in its treatment.

In cases of *Drowning*, life is often recoverable, although the sufferer has

been immersed in the water for a considerable time; for it must be borne in mind that, though *immersed*, he may very probably not have been *submersed*. The period after which life ceases to be recoverable in cases of submersion, cannot be very accurately estimated. The officers of the Humane Society, who have great experience in these matters, state that most generally persons are not recoverable who have been more than four or five minutes under water. In these cases, however, although submersion may not continue for a longer period than this, the process of asphyxia does; this condition not ceasing on the withdrawal of the body from the water, but continuing until the blood in the pulmonary vessels is aerated, either by the spontaneous or artificial inflation of the lungs. As several minutes are most commonly consumed in withdrawing the body from the water and conveying it to land, during which time no means can be taken to introduce air into the lungs, we must regard the asphyxia as continuing during the whole of this period; occupying, indeed, the time that intervenes between the last inspiration before complete submersion, and the first inspiration, whether artificial or spontaneous, after the removal of the body from the water. The latest time at which life can be recalled, during this period, is the measure of the duration of life in asphyxia. If, during this period, the action of the heart should cease entirely, I believe, with Sir B. Brodie, that the circulation can never be restored. But although we may put out of consideration those marvellous cases of restoration of life that are recorded by the older writers, and which are evidently unworthy of belief, are we to reject as exaggerated and apocryphal cases such as that by Mr. Smethurst, in which recovery took place after ten minutes' submersion; that by Dr. Douglas of Havre, in which the patient was not only submersed, but had actually sunk into, and was fixed in the mud at the bottom of the harbour for from twelve to fourteen minutes, or that by Mr. Weeks, in which the submersion, on the testimony of the most credible witnesses, exceeded half an hour? I think that it would be unphilosophical in the extreme to deny the facts clearly stated by these gentlemen; the more so that in these, as in many other instances of apparent death from drowning, life appears to have been prolonged by the patient falling into a state of syncope at the moment of immersion. We must therefore not despair of recovery, but should employ means of resuscitation, even though the body has been actually under water a considerable time.

There are certain minor means often employed in the case of persons who have been immersed in water, and are apparently drowned, which appear to be well adapted for the treatment of the less severe forms of asphyxia, or rather cases of syncope from fright and immersion in cold water. These consist, after the nose and mouth have been cleared of any mucosities, in the application of heat by means of a bath at about the temperature of 100° Fahr until the natural warmth is restored; in the employment of brisk friction and in passing ammonia to and fro under the nostrils. It is evident that these measures can have no direct influence upon the heart and lungs, but can only act as general stimuli to the system, equalising the circulation if it be still going on; and, by determining to the surface, tending to remove those congestions that are not so much the consequences of the asphyxia, as of the sojourn of the body for several minutes in cold water; they would therefore be of especial service during the colder seasons of the year. A hot bath may also, by the shock it gives, excite the reflex respiratory movements. With the view of doing this with a greater degree of certainty, cold water should be sprinkled or dashed upon the face at the time when the body is immersed in the hot bath, as in this way a most powerful exciting influence

can be communicated to the respiratory muscles; and the first object of treatment in all cases of asphyxia—the re-establishment of respiration—would more rapidly and effectually be accomplished; deep gaspings ensuing, by which the air would be sucked into the remotest ramifications of the air-cells, arterialising the blood that had accumulated in the pulmonary vessels, enabling it to find its way to the left cavities of the heart, and thus to excite that organ to increased activity. These means, then, are useful in those cases of asphyxia in which the sufferer has been but a short time submerged, and in which the heart is still acting, and the respiratory movements have either begun of their own accord on the patient being removed from the water, or in which they are capable of being excited by the shock of a hot bath, aided by the dashing of cold water in the face. At the same time, the lungs may be filled with pure air, by compressing the chest and abdomen, so as to expel the vitiated air, and then allowing them to recover their usual dimensions by the natural resiliency of their parietes. A small quantity of air will, in this way, be sucked in each time the chest is allowed to expand, and thus the re-establishment of the natural process of respiration may be much hastened. This simple mode of restoring the vital actions should never be omitted, as it is not attended with the least danger, and does not in any way interfere with the other measures employed. Dr. M. Hall has recommended that the patient be turned prone, so that the tongue may hang forwards, and the larynx thus be opened; and that respiration be then set up by gentle pressure along the back, and by turning the patient on his side at regular intervals. If, by these means, we succeed in restoring the proper action of the respiratory movements, it will merely be necessary to pay attention to some points of the after-treatment that will presently be adverted to. Should we, however, fail in restoring respiration, we should have recourse to other and more active measures.

In the more severe cases of asphyxia, warmth should be applied by means of a hot-air bath, by which not only the natural temperature of the body may be re-established, but the blood in the capillaries of the surface be decarbonised. The most direct and efficient means, however, that we possess for the re-establishment of the circulation in these cases, is certainly *Artificial Respiration*. In this way alone the pulmonary artery and the capillaries of the lungs can be unloaded of the blood that has stagnated in them, and the left side and substance of the heart will be directly and rapidly supplied with red blood. The whole value of artificial respiration depends, however, upon the way in which it is employed. Inflation from the mouth of an assistant into the nostrils or mouth of the sufferer, though objectionable, as air once respired is not well fitted for the resuscitation of the few sparks of life that may be left in the cases in which it is desirable to employ this means, is yet in many instances the readiest and indeed the only mode by which respiration can be set up; it should, therefore, always be had recourse to in the first instance, or until other and more efficient means can be got ready.

The bellows, if properly constructed for artificial inflation, so that the quantity of air injected may be measured, are no doubt very useful; and if furnished with Leroy's trachea-pipes, or what is better, with nostril-tubes, may be safely employed. About fifteen cubic inches of air may be introduced at each stroke of the bellows, and these should be worked ten or a dozen times in a minute. The lungs should be emptied by compression of the chest before beginning to inflate, and, after each inflation, by compressing the chest and abdomen; but care must also be taken not to employ much force, lest the air-cells be ruptured. But a safe, and at the same time

a very efficient mode of introducing pure air into the lungs, is by the elastic expansion of the walls of the chest. This may be effected in various ways, either by means of the split sheet, as recommended by Leroy and Dalrymple (Fig. 143), or else by alternately compressing the chest and abdo-



Fig. 143.—Split Sheet applied.

men with the hand, and then removing the pressure so as to allow the thorax to expand by the natural resiliency of its parietes, and thus, each time it expands, to allow a certain quantity of air to be sucked into the bronchi. The method recommended by Dr. Silvester, and now adopted by the Royal Humane Society, effects this purpose with great ease and certainty. It is carried out in the following way. The patient is laid on a flat surface on his back, with the head and shoulders slightly raised on a pillow. His arms are then to be grasped just above the elbows, and to be drawn gently and steadily upwards until they meet above the head, in which position they are kept for two seconds; they are then to be turned downwards, and to be pressed for two seconds gently and firmly against the sides of the chest. These movements are to be repeated deliberately about fifteen times in the minute, until natural efforts at respiration are induced, when they are to be discontinued, and the ordinary means to promote circulation and warmth had recourse to. The quantity of air introduced need not be large; for, by the law of the diffusion of gases, if fresh air be only introduced into the larger divisions of the bronchi, it will rapidly and with certainty find its way into the ultimate ramifications of these tubes. This last means of inflation has the additional advantage of resembling closely the natural process of respiration, which is one of expansion from without inwards, and not, as when the mouth or bellows are used, of pressure from within outwards. In one case the lungs are, as it were, drawn outwards, the air merely rushing in to fill up the vacuum that would otherwise be produced within the thorax by the expansion of its parietes; in the other they are forcibly pressed upon from within, and hence there is danger of rupture of the air-cells.

Inflation of the lungs with oxygen gas is likely to be of great service in extreme cases of asphyxia. I have found by experiment that the contractions of the heart can be excited by inflating the lungs with this gas, when the introduction of atmospheric air fails in doing so; and there are

cases on record in which resuscitation was effected by inflating the lungs with oxygen, when in all probability it could not have been effected with any other means. In my Essay on *Asphyxia* will be found a case of resuscitation, in which oxygen was successfully employed by Mr Weeks after the asphyxia had continued three-quarters of an hour. Whatever means of resuscitation are adopted, they should be continued for at least three or four hours, even though no signs of life show themselves; and after resuscitation the patient should be kept quiet in bed for some hours.

The danger of the supervention of *Secondary Asphyxia* after recovery has apparently taken place is much increased, and indeed is usually brought about, by some effort on the part of the patient that tends to embarrass the partially restored action of the heart and lungs. The patient, being to all appearances resuscitated, is allowed to get up and walk home, when the symptoms of asphyxia speedily return. Should symptoms of secondary asphyxia, such as stupor, laborious respiration, dilatation of the pupils, and convulsions, manifest themselves, artificial respiration should be immediately set up, and be maintained, until the action of the heart has been fully restored. In these cases I should, from the very great efficacy of electricity in the somewhat similar condition resulting from the administration of the narcotic poisons, be disposed to recommend slight shocks to be passed through the base of the brain and upper portion of the spinal cord, so as to stimulate the respiratory tracts.

Asphyxia from the *Respiration of Noxious Gases*, such as carbonic acid, is best treated by exposing the surface of the body to cold air, by dashing cold water upon the face, and by setting up artificial respiration without delay. If the impression of cold upon the surface do not excite these actions. There is a peculiar variety of this kind of asphyxia, which is occasionally met with among infants, the true nature of which was pointed out to me by the late Mr. Wakley, who, as coroner, had abundant opportunities of witnessing it, as it is not an uncommon cause of accidental death amongst the children of the poor. It is that condition in which a child is said to have been overlaid the child, sleeping with its mother or nurse, being found in the morning suffocated in the bed. On examination no marks of pressure will be found, but the right cavities of the heart and the lungs are gorged with blood, and the surface livid, clearly indicating death by asphyxia. That this accident is not the result of the mother overlaying her child, is not only evident from the *post mortem* appearances, but was clearly proved by a melancholy case to which I was called a few years ago, in which a mother, on waking in the morning, found her twin infants lying dead, one on each side of her. Here it was evident, from the position of the bodies, that she could not have overlaid both. The true cause of death in these cases is the inhalation of, and slow suffocation by, the vitiated air which accumulates under the bed-clothes that have been drawn, for the sake of warmth, over the child's head. In such cases as these, resuscitation by artificial respiration should always be attempted if any signs of life be left.

In cases of *Hanging*, death seldom results from pure asphyxia, but is usually the consequence, to a certain degree at least, of apoplexy, and commonly of simultaneous injury of the spinal cord. In these cases, bleeding from the jugular vein may be conjoined with artificial respiration.

If there should be a difficulty in setting up artificial respiration through the mouth or nose, as is more especially likely to happen when the patient has been suffocated by breathing noxious gases, or in cases of hanging, *tracheotomy* or *laryngotomy* should at once be performed, and the lungs inflated through the opening thus made in the neck.

INJURIES OF THE PHARYNX AND OESOPHAGUS.

WOUNDS of the oesophagus are chiefly met with in cases of cut-throat, in which, as has been already stated in treating of this injury, they occasion much difficulty by interfering with deglutition.

FOREIGN BODIES not uncommonly become impacted in the pharynx and oesophagus, and may produce great inconvenience by their size or shape. If large, as a piece of money or a lump of meat, the substance may become fixed in the lower part of the pharynx or the commencement of the oesophagus, which is narrowed by the projection of the larynx backwards, and, compressing or occluding the orifice of the glottis, may asphyxiate the patient at once. If the foreign body go beyond this point, it usually becomes arrested near the termination of the oesophagus. When it is small or pointed, as a fish-bone, pin, or bristle, it usually becomes entangled in the folds of mucous membrane that stretch from the root of the tongue to the epiglottis, or that lie along the sides of the pharynx. In some cases it may even perforate these, penetrating the substance of the larynx, and thus producing intense local irritation.

The Symptoms occasioned by the impaction of a foreign body in the food-passages are sufficiently evident. The sensations of the patient, who usually complains of uneasiness about the top of the sternum; the difficulty that he has in swallowing solids; and perhaps the occurrence of an urgent sense of suffocation, lead to the detection of the accident. Should any doubt exist, the surgeon may, by introducing his finger, explore nearly the whole of the pharynx, and should examine the oesophagus by the cautious introduction of a well oiled probang.

If the impaction be allowed to continue unrelieved, not only may deglutition and respiration be seriously interfered with, but ulceration of the oesophagus will take place, and abscess form either behind or between it and the trachea; or fatal hemorrhage may ensue.

It may happen that the foreign body, by transfixing the coats of the oesophagus, seriously injures some neighbouring parts of importance. Thus, in a curious case admitted into the University College Hospital, a juggler, in attempting to swallow a blunted sword, by pushing it down his throat, perforated the oesophagus and wounded the pericardium, death consequently resulting in the course of a few days.

The Treatment must depend upon the nature of the foreign body and its situation. Should it be of large size, blocking up the pharynx so as to render respiration impracticable, it may be hooked out by the surgeon's fingers. Should asphyxia have been induced, it may be necessary to perform tracheotomy at once, and to keep up artificial respiration until the foreign body can be extracted. If it be small or pointed, as a fish-bone or pin for instance, though it have lodged high up, the surgeon will usually experience great difficulty in its removal, as it gets entangled between and is covered in by the folds of the mucous membrane, where from its small size it may escape detection; and after it has been removed the patient will experience for some time a pricking sensation, as if it were still fixed. If the impacted body have passed low down into the oesophagus, the surgeon must deal with it according to its nature. If it be smooth and soft, as a piece of meat for instance, it may be pushed down into the throat by the gentle pressure of the probang. If, however, it be rough, hard, or sharp pointed, as a piece of earthenware or bone, or a metallic plate with false teeth attached, such a pressure would certainly cause perforation of the oesophagus, and serious mischief to the parts around; under these circumstances, therefore, an

attempt at extraction should be made by means of long slightly curved forceps, constructed for the purpose.

It occasionally happens that the foreign body has become so firmly impacted in the pharynx or œsophagus, that it cannot be extracted with any degree of force that it is prudent to use ; under these circumstances it may become necessary to open the tube and thus remove it. The operation of *Pharyngotomy* or *Œsophagotomy* is seldom called for ; but, if required, it may be performed by making an incision about four inches in length along the anterior border of the sterno-mastoid muscle on the left side of the neck, the œsophagus naturally curving somewhat towards this side. The dissection must then be carried with great caution between the carotid sheath and the larynx and trachea in a direction backwards, the omohyoid muscle having been divided in order to afford room. Care must be taken in prosecuting this deep dissection not to wound either of the thyroid arteries, more especially the inferior one, which will be endangered by carrying the incision too low. When the pharynx or the œsophagus has been reached, a sound or catheter should be passed through the mouth into this cavity, and pushed forwards so that its point may cause the walls to project, and thus serve as a guide to the surgeon. This must then be cut upon, and the aperture thus made in the gullet enlarged, by means of a probe-pointed bistoury, to a sufficient size to allow the removal of the extraneous substance.

CHAPTER XXVI.

INJURIES OF THE CHEST.

Wounds of the chest derive their principal interest and importance from the concomitant injury of the lungs, heart, or larger blood-vessels. When the soft parietes alone are wounded, the injury differs in nothing from similar lesions in other parts of the body ; except that it is usually slower in healing. This is especially the case when the muscular parietes are furrowed by bullets. If the surgeon be in doubt whether the cavity of the chest have been penetrated or not, he may endeavour to ascertain this point by careful examination with the finger ; but he should never introduce a probe ; it is better for him to wait and to be guided in his opinion by the symptoms that manifest themselves, rather than, by probing the wound, to run the risk of converting it into what he dreads—a penetrating wound of the chest.

INJURIES OF THE LUNG.

Rupture of the Lung from external violence has occasionally been met with, more commonly with, but in some instances without, fracture of the ribs or other sign of injury to the thoracic walls. The symptoms and consequences of such an injury closely resemble, indeed are identical with, those of a wound of the lung. These cases are not necessarily fatal, as is proved by two instances of recovery related by M. Gosselin.

Wound of the Lung is the most common and one of the most serious complications of injuries of the chest. It may occur without any external wound, from the ends of a broken rib being driven inwards upon this organ ; most frequently, however, it happens from a penetrating wound of the chest, by stab or bullet.

The *Symptoms* of this injury are sufficiently well marked. There is, in the first place, the immediate shock to the system that usually accompanies

the infliction of a severe injury; in this case amounting to extreme collapse, the patient at the same time being seized with considerable difficulty of breathing, followed by much tickling and irritating cough, and the expectoration of frothy bloody mucus, or perhaps of large quantities of pure blood. If there be an external opening, the air may pass in and out during the act of breathing; and emphysema, pneumothorax, or pneumonia will speedily supervene. On auscultating the chest immediately after the infliction of the injury, and before there is time for the supervention of any consequences, a loud rough crepitation will be distinctly audible at and around the seat of injury.

Complications—The principal dangers attending a wound of the lung arise from the bleeding, both external and internal, the occurrence of Hemothorax, Emphysema, Pneumothorax, Pneumonia, and Empyema.

1. The *Hemorrhage* is usually abundant and often fatal; the patient vomiting or spitting up a large quantity of florid frothy blood, by which he may be choked. If it do not prove fatal in the early period of the injury by the second day, this bloody expectoration generally ceases in a great measure in the course of forty-eight hours, giving way to sputa of a more rusty character. If the external wound be very free, there may also be copious bleeding from it; but not unfrequently the blood finds its way into the pleural sac rather than through the external aperture, and accumulates in it; and death may arise either from the exhausting effects of this internal and concealed hemorrhage, or from suffocation. The symptoms of this internal hemorrhage, *Hemothorax*, are those that generally characterise loss of blood, such as coldness and pallor of the surface, small weak pulse, and a tendency to collapse with increasing dyspnoea. The more special signs consist in an inability to lie on the uninjured side, with, in extreme cases, some bulging of the intercostal spaces, and an ecchymosed condition of the posterior part of the wounded side of the chest. The most important signs, however, are those that are furnished by auscultation. As the blood gravitates towards the back of the chest, between the posterior wall and the diaphragm, there will be gradually increasing dullness on percussion in this situation, with absence of respiratory murmur; the other portions of the lung, however, admitting air freely.

An ecchymosis of the loins described by Valentin, and noticed by Larrey and others, has been looked upon by some surgeons as pathognomonic of hemothorax, but its importance in this respect is secondary to the auscultatory signs, as in many cases it has not been met with, and in others of non-penetrating wounds of the chest it has occurred.

2. *Emphysema*, or the infiltration of air into the cellular tissue of the body, and *Pneumothorax*, or the accumulation of air in the cavity of the pleura, are not unfrequent complications of wounded lung, although not by any means invariably met with. These accidents more commonly occur when the external wound is small and oblique, than when it is large and direct, and not unfrequently happen in those cases in which the lung is punctured by a fractured rib, without there being any external wound. In the majority of cases, emphysema and pneumothorax occur together, but either may be met with separately. The mechanism of traumatic emphysema is most commonly as follows. The costal pleura being wounded and the lung injured, at every inspiration a quantity of air is sucked into the pleural sac, either through the external wound, or, if none exist, from the hole in the lung, thus giving rise to pneumothorax. At every expiration, the air that thus accumulates in the pleural sac, being compressed by the descent of the walls of the chest, is pumped into the cellular tissue around

the edges of the wound; and if this be oblique and valvular, being unable to escape wholly through it, it finds its way at each succeeding respiration further into the large cellular planes, first about the trunk and neck, and eventually, perhaps, into those of the body generally. Though this is the way in which emphysema usually occurs, it may be occasioned otherwise. Thus, for instance, I had once under my care a woman, who had extensive emphysema of the cellular tissue of the trunk from fractured ribs, but without any pneumothorax, the lung having been wounded at a spot where it was attached to the walls of the chest by old adhesions, and the air having passed through them into the cellular tissue of the body, without first entering the cavity of the pleura. Mr. Hilton has described a form of traumatic emphysema that arises from the rupture of an air-cell or bronchus without any external wound. The air, passing into the posterior mediastinum, and finding its way along the nerves and vessels in this situation, escapes through the cervical fascia which closes the upper part of the thorax, and thus reaching the neck diffuses itself along the sheaths of the arteries and nerves, along which it finds its way into the limbs; its appearance in which is first indicated by its extending along the course of the vessels.

The *Symptoms of emphysema* are very distinctly marked. There is a puffiness, swelling, pale, and crackling when pressed upon, at first confined to the neighbourhood of the wound, if there be one externally; if not, making its appearance opposite the fractured ribs, and gradually extending over the upper part of the trunk and neck, to which it is usually limited. In some cases, however, which are happily rare, the swelling becomes more general, the body being blown up to an enormous size, the features effaced, the movement of the limbs interfered with, respiration arrested, and suffocation consequently induced; after death, air has been found in all the tissues, even under the serous coverings of the abdominal organs. In *traumatic pneumothorax* there is a diminution or complete absence of the respiratory murmur on the affected side, with a loud tympanic resonance on percussion, puerile respiration in the sound lung, and considerable distress in breathing.

3. *Pneumonia* is an invariable sequence of wound of a lung, and constitutes one of the great secondary dangers of this injury; the inflammation that is necessary for the repair of the wound in the organ having frequently a tendency to extend beyond the part injured, and not uncommonly to terminate in abscess. Traumatic pneumonia resembles in all its symptoms, auscultatory as well as general, the idiopathic form of the disease. There are the same crepitation, dulness on percussion, and absence of respiratory murmur as hepatisation advances; with rusty sputa, much tinged with blood in the early stages. It differs, however, from the idiopathic form in having less tendency to diffuse itself throughout the lung, in being limited to the injured side, and in more frequently terminating in abscess, which, however, is often dependent on the lodgment of some foreign body, such as a piece of wadding or clothing, in the substance of the organ.

4. *Empyema*.—Empyema may come on whenever the pleura is wounded, whether it be by a fractured rib, or by direct open wound; and whether the lung be injured or not. Pleurisy necessarily acts in, and the repair of the injury in the serous membrane is effected by the effusion of lymph, which, in all cases in which the pulmonic pleura is injured, and hence in all cases of wounded lung, causes adhesions to form between it and the costal pleura, and thus obliterates to a certain extent the serous sac. If this inflammation run too high, if the constitution be unsound, or if blood or a foreign body be lodged, suppuration may take place, the existence of which

may be recognised by dulness on percussion and absence of respiratory murmur at the lower and posterior parts of the chest, up to a level that has a gradual tendency to ascend, and that varies according as the patient is upright or recumbent, withægophony at the upper part of the lung, until at last, the whole side of the chest being filled with pus, there are complete absence of all breath and voice sound, with increase of size on measurement, bulging of the intercostal spaces, compression of the lung against the spine; and, if the left pleura be filled, displacement of the heart towards the right side; if the right pleura be the seat of the accumulation, descent of the liver below its normal level.

Collapse of the Lung in wounds of the chest, consequent upon the action of the atmospheric pressure on the outside of the organ, has been more frequently spoken about than seen. The chest may be largely opened and the full pressure of the atmosphere allowed to act on the outer surface of the lung, and yet no collapse of this organ takes place. The lung in such cases may be seen rising and falling at the bottom of the wound. When collapse of the lung occurs in the early stage, it is, I believe, owing to compression by the air sucked into the cavity of the pleura by pneumothorax impact. In the latter stages it may be due to compression by hemothorax or empyema.

The *Prognosis* in wounds of the lungs is of course extremely unfavourable, but less so than that of similar injuries of most of the other viscera. The danger will depend greatly upon the mode of infliction of the wound and its extent. If the lung be wounded by the sharp end of a broken rib, recovery usually ensues. Punctured wounds of the chest, penetrating the lungs, are always very serious; but here the danger will depend partly on the depth of penetration, partly on the size of the instrument that occasions the wound. The nearer the wound penetrates to the root of the lungs, the greater is the danger from hemorrhage by the implication of the larger vascular trunk. Gun-shot wounds of the chest are far more dangerous than stabs, owing partly to the laceration attendant on a bullet-wound, but especially to the lodgment of the bullet or other foreign bodies, that so commonly occurs in these injuries. Guthrie states, that more than half of those who are shot through the chest die. After the battle of Toulouse, of 106 such cases, nearly half died; and of 40 cases at the Hôtel Dieu, 20 died. Of 147 penetrating gun-shot wounds of the chest occurring in the Crimean War in the British army, 120 died; and Messrs. Mout and Wyatt state that, of 200 cases of penetrating wounds of the chest occurring in the Russian army at the siege of Sebastopol, and treated at Simpheropol, only 3 recovered. The Russian surgeons, however, do not bleed in these cases, but use digitals instead. The great danger and principal cause of death in these injuries is unquestionably the hemorrhage that ensues. This may prove immediately fatal if one of the larger pulmonary vessels be lacerated. As the bleeding is most abundant at and shortly after the receipt of the wound, Hennen states that, if the patient survive the third day, great hopes may be entertained of his recovery. After this period, the chief source of danger is the occurrence of inflammation of the lungs and pleura, the extent and severity of which are greatly increased in gun-shot injuries by the frequent lodgment of foreign bodies within the chest. Emphysema is seldom a dangerous complication, though it may become so if very extensive and allowed to increase unchecked.

If both lungs be wounded at the same time, the result is almost inevitably fatal, either by the abundant hemorrhage suffocating or exhausting the patient, or else by induction of asphyxia in consequence of air being drawn

into both the pleural sacs, and thus, by compressing the lungs, arresting respiration. This, however, does not necessarily result; and there are a sufficient number of cases on record of recoveries after stab or bullet wounds traversing both sides of the chest, to show that collapse of the lungs and consequent asphyxia does not necessarily result from this double injury, which indeed has also been determined experimentally on animals by Cruveilhier.

The *Treatment* of wounds of the chest, implicating the lungs, must have reference to various sources of danger that have just been indicated.

The *Local Treatment* is of a very simple character. If the wound have been made by a bullet, all foreign bodies that are within reach should be extracted. If there be any difficulty in doing this, it may be necessary to enlarge the aperture and then to remove them; but the surgeon must not go too deeply or perseveringly in search of them, lest he excite more irritation than the foreign body would. Light water-dressing should then be applied, no attempt being made to close the aperture, so that the escape of any extraneous substance that may have been left, or of extravasated blood, may not be interfered with.

If the wound be a clean puncture, without escape of air or much hemorrhage, the edges may be brought together and closed by means of stitches, plasters, and collodion, so that the bleeding may be arrested, and the patient enabled to breathe with more ease. Should the wound be large and deep, blood and air issuing freely through it from the injured lung, it should not be closed, but the patient should be laid on the wounded side, and a piece of water-dressing applied, otherwise emphysema or hemothorax will certainly occur.

In wounds of the chest-walls, the *intercostal arteries* usually seem to escape; or at least, if wounded, they do not bleed in a troublesome manner. Should profuse hemorrhage occur from this source, I believe that the only safe mode of arresting it is to open up the wound, and, if necessary, to enlarge it so as to reach the bleeding vessel. Should this fail, compression must be trusted to. An infinity of devices have been recommended for the suppression of this kind of hemorrhage; but they are for the most part so little applicable to practice, and indeed, the complication is so rare in chest-wounds, that it is needless to refer to them. e

Wounds of the internal mammary artery are of rare occurrence, considering its exposed situation. They may, however, occur if the chest be penetrated in front through the intercostal spaces or costal cartilages. The danger in these cases is from the hemorrhage taking place slowly into the anterior mediastinum, or one of the pleuræ, without any external bleeding revealing the mischief that is going on within. If the wound of the vessel be ascertained, an attempt should be made, by enlarging the external aperture, to seize and ligature the bleeding ends, cutting directly down upon them through the injured intercostal space; or the vessel might even be followed beneath one of the costal cartilages, if necessary, by cutting through this. Should much blood have already been extravasated, this must be removed through the external wound, by the introduction of a female catheter, or by the application of a cupping-glass over it, and the case then treated like one of effusion into the chest.

In the *Constitutional Treatment* of these injuries, the first indication consists in diminishing the quantity and force of the blood circulating through the lungs, and thus, by lessening the impulse of the heart and increasing the tendency for the blood to coagulate in the spongy pulmonary vessels, in endeavouring to arrest the hemorrhage from these organs. If this have been

very abundant, the collapse and fainting consequent upon the excessive loss of blood may tend to induce a natural cessation of the bleeding. But if this have not happened, free venesection to the extent of from at least twenty to thirty ounces, or even more, must be practised. In this way the bleeding may be stopped at once; should it recur, and the pulse rise, blood must be taken from the arm again and again. The most experienced surgeons are unanimous in their opinion, that at this stage of the injury the patient's safety lies in free and repeated venesection. John Bell, Hennen, and Guthrie, all concur in urging the necessity of free venesection so as to keep down the action of the heart and arteries. Whenever this rises and the cough or hemoptysis returns, recourse should be had to the lancet. In the Crimean campaign, Dr. Macleod states, that "those cases did best in which early, active, and repeated bleedings were had recourse to." Thus, however paradoxical and even irrational as it may appear to endeavour to restrain one hemorrhage by establishing another, the practice of taking away blood from the arm in cases of traumatic pulmonary hemorrhage is alike sound in principle and supported by experience. The patient must then be kept lying on the injured side, and have nothing but ice or barley-water allowed.

If the patient survive the third day, the danger to be apprehended is no longer from hemorrhage, but from inflammation within the chest. Here also bleeding must be practised, though it need not be done to the same extent as in the earlier stages of the injury. The inflammation must also be combated by a rigid diet, and by the administration of antimonials. In fracture of the ribs with wounded lung, the same line of treatment requires to be adopted; but when the accident occurs in elderly people, we may advantageously substitute calomel and opium for the antimonials.

If extravasation of blood into the pleura be going on, its farther effusion must, if possible, be arrested by the same means that are adopted for the stoppage of external hemorrhage. When the bleeding has been checked in this way, the blood must early be let out from the pleural sac; for, if it be allowed to remain there, it will speedily putrefy, giving rise to extensive formation of pus in the cavity. In order to prevent this occurrence, the wound should be opened freely with a probe-pointed bistoury at the fifth or sixth day after the injury, so that the blood may be discharged. If it do not readily come away, a cupping glass may be applied over the aperture, and thus it may be withdrawn. Should, however, the hemorrhage continue notwithstanding the employment of the means indicated, Guthrie advises that the wound should be closed, so that the blood that flows into the pleural sac may, by accumulating in this, compress the lungs, and thus arrest the further escape of blood from the wounded vessels. the patient at the same time should be made to lie on the injured side, in order to increase the pressure exercised upon the wounded and bleeding organ. On the sixth or eighth day the chest should be tapped, or the wound opened again, in order to evacuate the extravasation, and prevent its acting as an irritant to the pleura, or, by permanently compressing and consolidating the lung, rendering this useless.

In all cases of purulent effusion into the chest, Guthrie advises, with good reason, that tapping should be early performed, in order that the lung may not be drawn down by false membranes, and consequently, being unable to expand, lead to permanent flattening of the side and impairment of respiration.

If any extraneous body, such as a bullet, a piece of wood, or of clothing, have penetrated too deeply into the chest to be readily extracted through the external wound, it would not be safe to make incisions or exploratory researches, with a view of extracting it; for, though its pro-

sence would increase the patient's danger, yet attempt at extraction would not only add to this, but in all probability be fatal. In many cases, however, no lodged form an abscess around them, are loosened, and eventually are spat up, or appear at the external wound. In other cases, they remain permanently fixed in the chest, becoming enveloped in a cyst, and so remaining for years, without producing irritation. In this way Hennen states that a bullet has been lodged in the chest for upwards of twenty years, and Vidal mentions a man who lived for fifteen years with the broken end of a foil in his chest, which, after death, was found sticking in the vertebrae, and stretching across to one of the ribs.

The Treatment of *emphysema* consists of little in addition to what is called for by the wounded lung. In many cases, indeed, the air becomes rapidly absorbed, without the necessity of any local interference. In others, again, the pressure of a bandage may be required. If, however, the *emphysema* be so extensive as to interfere with respiration, the external wound must be freely opened, and scarification made into the cellular tissue, so as to give exit to the air. I doubt whether *emphysema* alone can ever prove fatal. If, however, both sides of the chest be opened, it is possible that the accompanying *pneumothorax* may so interfere with the due expansion of the lung, as to produce an asphyxial condition that may prove fatal.

HERNIA OF THE LUNG, OR PNEUMATOCELE.—Hernia of the lung is an affection of extremely rare occurrence. It consists in the protrusion of a portion of this organ at some part of the thoracic walls, so as to form a tumour under the skin. It has most frequently been met with after an external wound, under the cicatrix of which the hernial swelling has appeared; but it has been known to occur from fractured ribs without any wound, and even from violent straining during labour. In these cases it is probable that, the intercostal muscles and costal pleura having been divided or ruptured by the efforts of the patient, and not having united afterwards, the lung has, during expiration, gradually insinuated itself into the aperture so formed, until at last the hernial tumour has appeared.

This protrusion may take place at any part of the thoracic parietes: thus Velpeau has observed it in the supraclavicular region of a girl; but most commonly it occurs on one or other side of the chest. The tumour may attain a large size; I have heard Velpeau state that he has seen one half as large as the head. It does not appear to shorten life.

The only case that has fallen under my own observation is one that I saw in 1839, in Velpeau's wards at La Charité; and as the signs of the affection were well marked in this case, I may briefly relate it, from notes taken at the time. A man twenty-nine years of age, left handed, received in a duel a sword-wound at the inner side of, and a little below, the left nipple, he lost a considerable quantity of blood, but did not spit up any. The wound healed in about a fortnight, shortly after which he noticed the tumour, for which he was admitted three months and a half after the receipt of the injury. On examination, an indurated cicatrix about half an inch in length was found a little below, and to the inner side of, the left nipple. On inspiring or coughing, a soft tumour of about the size of an egg appeared immediately underneath the cicatrix, which it raised up; it subsided under pressure, or when the patient ceased to inspire or to cough; and its protrusion might be prevented by pressing the finger firmly on the part where it appeared, when a depression was felt in the intercostal muscles. If the fingers were slid obliquely over the tumour, it yielded a fine and distinct *crepitation*, exactly resembling that produced by compressing a healthy lung, and the spongy tissue of the organ could be distinguished. On apply-

ing the ear, a fine cracking and rubbing sound was distinctly perceived; the tumour was resonant on percussion. The portion of protruded lung did not appear to re-enter the chest on expiration, but was firmly fixed in its new situation. No treatment was adopted in the case, nor does any appear admissible in similar instances.

The only affection with which a hernia of the lung can be confounded, is a circumscribed emphyema which is making its way through the walls of the chest. Here, however, the dulness on percussion, and the absence of respiratory murmur and of cracking under the fingers, will readily enable the surgeon to make the diagnosis.

It occasionally happens in extensive wounds of the chest that a portion of the lung protrudes during efforts at expiration. If the wound be free, the protruded lung may return on pressure, or during inspiration. If left unreturned, it soon becomes livid and gangrenous; under these circumstances it may be removed by the knife or ligature; but Guthrie advises that the protruded part should never be separated from the pleura costalis by which it is surrounded at its base, so that the cavity of the thorax may not be opened: the wound must then be closed in the usual way.

WOUNDS OF THE HEART AND LARGE VESSELS.

INJURY OF THE PERICARDIUM.—The pericardium may be injured without the heart being wounded; by stabs, by gun-shot violence, or by severe contusions of the chest. In injuries such as these, inflammation is set up, and the ordinary auscultatory signs of pericarditis, such as friction or creaking sounds, with dulness on percussion, are distinctly perceptible. When blood is effused into the pericardial sac, these morbid sounds may be absent; but the heart's impulse is weak, and the circulatory sounds distant, the layer of blood preventing, as Mr. Guthrie has pointed out, the contact of the pericardial surfaces, and thus interfering with the production of those sounds which are dependent on this contact.

WOUNDS OF THE HEART are generally at once fatal, from the sudden loss of blood and the severe shock that the patient sustains. There are many cases on record, however, of persons who have walked or run some considerable distance after receiving a wound in the heart, before falling down dead. Olivier and Sanson have collected 29 cases of penetrating wounds of the heart, which did not prove fatal in the first forty-eight hours after the receipt of the injury. On analysing these, it would appear that the rapidity of death depends greatly on the direction of the wound and the part of the organ injured. When the wound is parallel to the axis of the heart, it is not so speedily fatal as when in a transverse direction, and wounds of the auricle are more immediately followed by death than those of the ventricle; the irregular contraction of the different planes of muscular fibre that enter into the formation of the wall of the ventricle tending to obstruct the free passage of the blood through the wound, and perhaps to close it entirely. The size of the wound, however, will necessarily influence the result more materially than its direction. Without referring to numerous cases recorded by the older surgeons, there are a sufficient number of instances reported by modern writers to prove that an individual may live for many days, and even recover altogether from the effects of a wound by which the cavities of the heart have been penetrated, although with a foreign body lodged in them. Thus Ferrus relates the case of a man who lived for twenty days with a skewer traversing the heart from side to side. Messrs. Davis and Steward found a piece of wood, three inches long, in the right ventricle of a boy, who lived five weeks after the accident had happened; Latour records the

case of a soldier who lived for six years after being wounded with a musket-ball in the side, and in the right ventricle of whose heart the bullet was found lodged, lying against the septum; and Carnochan relates a case in which the wounded man survived eleven days with a bullet deeply lodged in the substance of the apex of the heart.

From the inquiries of Ollivier it would appear that the right ventricle is more frequently wounded than the left; next, the apex or base of the heart, then the right auricle; and least frequently the left auricle.

The *Signs* of an injury of the heart that is not immediately fatal, are not very positive. The hemorrhage, the direction of the wound, the dyspnoea, the extreme anxiety, syncope, and irregularity with smallness of the pulse, indicate the probable nature of the mischief. The most important information, however, is to be derived from auscultation; the occurrence of friction, or some other abnormal sound, with absence of impulse, and increased dullness on percussion over the region of the heart, may point to the seat of the injury.

RUPTURES OF THE HEART FROM EXTERNAL VIOLENCE, without penetrating wound of the chest, are not of frequent occurrence. Mr. Gaingee has, however, collected 27 published cases of this accident. On analysing these he finds that, in at least one half of the cases, the pericardium was intact—12 of the ruptures were on the right, 10 on the left side. The right ventricle was ruptured in 8, and the left in 3 cases; whereas the left auricle was torn in 7, and the right only in 4 instances. Death is usually nearly instantaneous, though there are instances on record in which the patient has made some exertion after the rupture had taken place, and has even lived for several hours. In a case of rupture of the right auricle recorded by Rust the patient survived fourteen hours. In most of the recorded cases, the injury occasioning the rupture was directly applied to the region of the heart. But instances are not wanting in which this organ has been found ruptured through one or both ventricles or in one of the auricles, without any evidence of direct injury in the cardiac region—the patient having fallen upon his head or shoulders, or having been merely thrown forcibly to the ground with serious injury to the lower extremities. In some of these cases there is reason to believe that the rupture was produced by the spasmodic violence of the contractions of the heart under the influence of great mental emotion or fear. The only case that has occurred in my practice was that of a man brought into the hospital dead, having fallen from the top of a cart. The right shoulder was bruised, and the clavicle broken—showing clearly that he had pitched on that side: there was no other bruise about the body, or evidence that the wheels had passed over him. On examination the liver was found extensively torn, in fact smashed, and the pericardium was distended with blood—there being a triangular ragged aperture at the anterior part of the auricular appendage of the left auricle, through which it had escaped.

WOUNDS OF THE AORTA AND VENA CAVA are as fatal as those of the heart itself. Dr. Heil has, however, recorded a case in which the patient recovered and lived for a twelvemonth, after receiving a stab that penetrated the ascending aorta.

CHAPTER XXVII.

INJURIES OF THE ABDOMEN AND PELVIS.

INJURIES OF THE ABDOMEN AND ABDOMINAL VISCERA.

INJURIES of the abdomen are of frequent occurrence. They may be divided into Contusions of the Abdomen, with or without Rupture of Internal Organs; into Non-penetrating Wounds, and into Penetrating Wounds, either uncomplicated, or conjoined with Injury or Protrusion of some of the Organs contained in this cavity.

CONTUSIONS OF THE ABDOMINAL WALLS from blows or kicks usually terminate without serious inconvenience, but in some cases are followed by peritonitis of a very acute character, which may prove fatal.

In other cases again, the abdominal muscles may be ruptured, although the skin may remain unbroken. A man was admitted under my care into the hospital, having received a blow from the buffer of a railway carriage upon his abdomen. He complained of great pain at one spot; and, on examination after death, we found the rectus muscle torn across without injury either to the integuments or the peritoneum. If the patient live, an injury of this kind is apt to be followed by atrophy of the muscular substance, and perhaps by the occurrence of a ventral hernia at a later period. Occasionally the contusion is followed by abscess in the abdominal wall, which has a tendency to extend widely between the muscular planes. These abscesses should be opened early, lest they burst into the peritoneal cavity and occasion fatal inflammation.

BUFFER-ACCIDENTS.—A contusion of the abdomen is often associated with *Rupture of some of the Viscera*. In military practice these internal injuries are met with in the so-called "wind-contusions;" in civil practice they commonly result from blows, kicks, the passage of a cart-wheel over the abdomen, or the squeeze of the body between the buffers of two railway carriages. These "*Buffer-accidents*" are now of common occurrence in hospital practice, resulting usually from the carelessness of railway guards and porters, who, trying to pass between carriages in motion, are caught and squeezed between the buffers. In these cases the most fearful internal injuries occur, often without an external wound. A man was admitted under my care into University College Hospital, in whom the liver, stomach, spleen, and kidneys, were crushed and torn; the heart was bruised, being ecchymosed on its surface, and one of the lungs lacerated, without there being any rupture or bruise of the skin or fracture of the ribs. In this way any of the abdominal organs may be torn or contused, the particular one injured depending on the situation of the blow. The organ that is most frequently crushed in this way is the liver, owing to its large size and the ready lacerability of its structure; the other solid organs, such as the spleen and kidneys, do not suffer so frequently: the pancreas I have never seen injured. Among the hollow organs the stomach most commonly suffers, and it is especially likely to do so if distended by a meal at the time when it is struck. Any portion of the intestinal canal may be lacerated. I have seen the duodenum, the ileum, the jejunum, and the large intestine ruptured in different cases: the mesentery likewise may be torn, and the spermatic cord snapped across.

The sufferer usually dies in the course of a few hours, or at the utmost at the end of two or three days after the receipt of these severe injuries, from hemorrhage into the abdominal cavity, conjoined with shock to the system. It is seldom that life is prolonged sufficiently for peritonitis to be set up, though this is the chief danger to be apprehended in those cases that survive the more immediate effects of the accident. The shock of itself may, however, prove fatal, though there be but little internal mischief done; thus, I have seen a man die collapsed eight hours after a buffer accident, in which no injury was found except a small rupture of the mesentery, attended with but very slight extravasation of blood. The severity of the shock, amounting often to prolonged and complete collapse, is one of the most remarkable phenomena attending these injuries. It is, doubtless, due to concussion of the great sympathetic. The continuance of the shock may be maintained and its intensity increased, by internal hemorrhage, which, when the solid organs are ruptured, is the most common cause of death. So far as my experience goes, I would say that the shock is most severe in injuries of and about the stomach, probably from lesion of the great solar plexus. It does not follow, however, that these injuries are necessarily fatal. Patients have lived after all the signs of rupture of the liver or the kidneys, passing bloody urine, and having circumscribed peritonitis, and, when death has occurred at a later period, cicatrices have been detected in these organs; this indeed is nothing more than has been met with in ordinary penetrating wounds of the abdomen. A patient was admitted under my care into the University College Hospital for a severe blow upon the back, followed by hematuria and other symptoms of renal injury; on his death from pneumonia nine weeks after the accident, an extravasation of blood, with the marks of recent cicatrization, was found in the left kidney.

Rupture of the liver is by no means invariably speedily or even necessarily fatal. It may be so from great extravasation of blood; but when this is not largely poured out, the patient may live for some considerable time, though he may eventually succumb to traumatic peritonitis. A man was once admitted under my care into the University College Hospital, who had been crushed between the buffers of two railway carriages. He was collapsed, and apparently moribund, but rallied in a few hours. Two days after the accident, great pain and tenderness in the right hypochondrium were complained of, and dulness on percussion was found to extend as low as the umbilicus. He became jaundiced, and there were symptoms of low peritonitis; these were followed by great swelling of the abdomen, which became tympanitic; the peritonitis continued, and symptoms of intestinal obstruction came on, the dulness increasing, with fluctuation in the flanks. He died on the sixteenth day after the accident, and on examination no less than 240 ounces of bilious fluid, mixed with flakes of lymph, were found in the abdominal cavity; the obstruction being dependent on the pressure of this effusion, and on the matting together of the intestines by lymph. There was a large rent found in the thick border of the liver, which was beginning to cicatrize. Injury over the region of the liver followed by peritonitis and jaundice, and probably occasioning laceration of that organ, may be recovered from. Of this I have had several instances in my own practice; and Bernard has shown that contusions of the liver may be followed by the production of traumatic saccharine diabetes.

The *Symptoms* of an internal abdominal injury are often extremely equivocal. If the *liver* or *spleen* have been lacerated, there will be all the effects of severe shock of the system, accompanied by those of internal hemorrhage, coldness, and pallor of the surface, a small and feeble pulse, anxiety of

countenance, and great depression of the vital powers, with pain at the seat of injury, and perhaps dulness on percussion from extravasated blood; symptoms that speedily terminate in the death of the patient. If the *kidneys* be injured, the patient will commonly experience a frequent desire to pass urine, and this will be tinged with blood, often to a considerable extent. The absence of blood from the urine must not, however, be taken as an indication that the kidney is not injured; it may be so disorganised as to be totally incapable of secreting, and consequently no bloody urine finds its way into the bladder. A man was admitted into the hospital under my care for a *bullet-injury* of the back; he passed urine untinged with blood, but after death his right kidney was found completely smashed by the blow, with an extensive extravasation of blood in the cellulose adipose tissue around it; here it was evident that the disorganisation was so sudden and complete, that no bloody urine had found its way into the bladder.

When the *stomach* is ruptured, it commonly happens that the nature of the accident is revealed by bloody vomiting; and when the *intestines* have been torn, by the admixture of blood with the stools, if the patient live long enough to pass any. These signs, however, do not occur in all cases. A man was admitted into the hospital under my care, whose abdomen had been squeezed between a cart-wheel and a lamp post; during the five hours that he lived after the accident, he vomited several times, bringing up a meal which he had taken immediately before. In the vomited matters there was no blood to be seen; but on examination after death it was found that not only the liver and spleen were ruptured, but the stomach was torn almost completely across near the pylorus.

Emphysema of the abdominal wall, and subsequently of the trunk generally, may result from the escape of flatus from wounded intestine into the subperitoneal cellular tissue, and thence into the more superficial cellular planes. When this takes place, the same doughy, puffy, inelastic, crepitating swelling of the subcutaneous cellular tissue, that is met with in the thoracic form of the affection, is observed. The emphysema usually commences in one or the other flank, and may then creep on up towards the axilla, or in front of the abdominal wall.

As a diagnostic sign, this form of emphysema is valuable in those cases in which the intestines have been injured, either without any wound of the abdominal parietes, or, if there be wound, without protrusion of the injured portion of gut. In two of the cases in which I have observed it, this condition was the only positive sign of intestinal injury. In one case the transverse duodenum had been ruptured where uncovered by peritoneum, by a *bullet-accident*; and in the other the rectum and mesorectum had been traversed by a pistol ball. In both these cases the emphysema was extensive, the flatus having directly passed into the subperitoneal cellular tissue. In other cases it may do so more indirectly by having, in the first instance, passed into the cavity of the abdomen, and rendered that tympanitic, and so, as in thoracic emphysema from pneumothorax, escaped from this into the cellular tissue at the edges of the wound. In a third case, it occurred as a consequence of tapping the bladder through the rectum. The flatus escaped after the removal of the cannula on the sixth day through the small apertures in the walls of the gut into the subperitoneal cellular tissue of the pelvis, thence through the sciatic notches down the posterior and outer part of the thighs and the flanks.

The diagnosis of abdominal emphysema requires to be made from thoracic emphysema and from putrefactive infiltration of air into the cellular tissue. In the first case it may readily be effected by observing an absence of the

signs of thoracic injury, and by the situation of the emphysema in the posterior or lateral abdominal wall, or around the lips of a wound. From putrefactive infiltration with air the abdominal emphysema is easily distinguished by the cause, and by the absence of low inflammation of the cellular tissue.

The *Treatment* of the various injuries of the abdomen that have just been described is of a very simple character. If the symptoms indicate laceration of one of the viscera, little can be done during the state of collapse supervening on the accident, beyond keeping the patient quiet, and employing the means that have been recommended for lessening the effects of shock upon the system. If the patient survive this period, we must guard against the supervention of peritonitis, and limit, if possible, the extravasation of blood into the abdomen, should there be indications of its occurrence, by the employment of treatment that will presently be described.

WOUNDS OF THE DIAPHRAGM may be occasioned by stabs or by gun-shot injury. Sometimes, however, this muscle is perforated by the fragment of a broken rib without external wound. These injuries are necessarily usually complicated with so much visceral injury as to be very generally followed by death, though not in themselves mortal. If the patient survive, the aperture may be blocked up by a false membrane, to which the adjacent lung will probably adhere; and thus the separation between the cavities of the chest and abdomen will be maintained. Should this reparative action not take place, a hernial protrusion of some of the abdominal viscera may take place into the pleural cavity, as will be more fully described when we speak of "Diaphragmatic Hernia."

WOUNDS OF THE ABDOMEN.—*Wounds of the Abdominal Wall that do not Penetrate the Peritoneal Cavity*, if uncomplicated with internal injury, usually do well, and require to be treated on ordinary principles. If they be incised, and so extensive as to require sutures, the stitches should be introduced through the skin alone, never through muscular or tendinous structures, the union of which could not be effected in this way; the parts injured must also be relaxed by careful attention to position. When they are the result of gun-shot injury, they suppurate extensively, and are very slow in healing.

Wounds that Penetrate the Cavity of the Abdomen are of especial interest, on account of the frequency with which they are complicated with peritonitis, and with injury of some of the viscera. They may, for practical purposes, be divided into 1, those that penetrate the peritoneal sac, without wounding or causing the protrusion of any of the contained organs; and 2, those that are complicated with protrusion or wound of some of the viscera.

1. *Penetrating Wounds of the Abdomen without Visceral Protrusion or Injury*, are often somewhat difficult to distinguish from simple wounds of the abdominal wall, though the escape of a small quantity of reddish serum may reveal the nature of the accident. In these cases the surgeon should be careful not to push his examination too far, by probing or otherwise exploring the wound, lest he bring about the very injury he is anxious to avoid. The cavity of the peritoneum has often been perforated from front to base by bullet-wounds or sword-thrusts, without there being any sign of visceral injury. In the absence of peritonitis or other signs of mischief, the wound must be treated as a simple one of the abdominal wall, and any complication that may occur must be met in the way that will immediately be described.

2. In a *Penetrating Wound with Protrusion or Injury of the Viscera*, the risk is necessarily greatly increased; here the chief danger is from peritonitis, induced either by the wound, by the extravasation of the intestinal contents into the peritoneal cavity, or by the accumulation of blood in it.

It but seldom happens that death results from hemorrhage in these cases, though this may, of course, occur if any of the larger vessels be injured.

Protrusion of uninjured intestine, mesentery, or omentum, may take place through the wound in the abdominal wall. This protruded mass is always of very large size in comparison with the aperture from which it escapes, the sides of which, being overlaid by it, constrict it pretty tightly, so as to form a distinct neck to the protrusion. If left unreduced, the mass speedily loses its polish and bright colour, becoming dull and livid from congestion; it then inflames, and soon becomes gangrenous from the pressure exercised upon it by the sides of the aperture through which it has passed.

In many cases the *protruded intestine is wounded*. The existence of this further injury will readily be ascertained by the escape of flatus, or of the more fluid contents of the gut. The characters of the wound vary, as Travers has pointed out, according to its size. If it be a mere puncture in the gut, or even an incision two or three lines in length, an eversion or prolapsus of the mucous membrane will take place, so as to close it to an extent sufficient to prevent the escape of its contents. If the aperture be above four lines in length, this plugging of it by everted mucous membrane cannot take place, and then the contents of the bowel are more freely discharged; but even under these circumstances, there will be a tendency to the protrusion of the membrane, which forms a kind of lip over the edge of the cut.

A *wounded intestine which does not protrude*, but remains within the peritoneal sac, presents the same conditions. In these cases, however, there is the additional danger of the extravasation of the intestinal contents into the peritoneal cavity. This *extravasation of feculent matter*, unquestionably one of the greatest dangers that can occur in wounds of the abdomen, inasmuch as by its irritating qualities it gives rise to and keeps up the most intense peritonitis, takes place less frequently than might be expected. For this there are several reasons. In the first place, we have already seen that, if the wound in the gut be below a certain size, there is a natural tendency to its occlusion by eversion of the mucous membrane into it. Besides this, it must be borne in mind that, though in ordinary language we speak of the "cavity" of the abdomen, there is in reality no such thing; there being no empty space within the peritoneal sac into which extravasated matters could fall, but the whole of the visceral contents of the abdomen being so closely and equally brought into contact by the pressure of the abdominal muscles and of the diaphragm, that it requires some degree of force for the intestinal contents to overcome this uniform support, and to insinuate themselves between the coils of contiguous portions of intestine. The influence exercised by the continuous pressure of the abdominal walls upon the intestinal contents, is well shown by the greater facility with which these escape from a *portion of wounded intestine that has been protruded*, than from one that is still lying within the abdomen. In the former case, faeces will escape from a much smaller aperture than in the latter instance, in consequence of the gut not being supported on all sides by the uniform pressure to which it is subjected within the abdomen. It is seldom, indeed, that faeces are extravasated from gut that is not protruding, unless it be very full at the time of the injury, or the wound in it be very extensive. The influence of the equable pressure of the abdominal contents in preventing the escape of faeces was well illustrated in a case in University College Hospital, of a man who was shot through the abdomen. The intestines, which contained much feculent matter, were traversed by the bullet in four places. He lived twenty four hours, and yet no feculent extravasation took place. In another

case to which I was called, that of a young gentleman who had been accidentally shot through the abdomen with the ramrod of a horse-pistol, the descending colon was cut across, and the small intestines perforated in two places, and yet no extravasation had taken place, though he survived the accident two days.

Blood is extravasated more readily than the intestinal contents in wounds of the abdomen. This is in a great measure owing to the *vis à tergo* existing in an artery of moderate size, such as one of the branches of the mesenteric, being sufficient to overcome the equable pressure and support of the abdominal walls.

These extravasations, whether of feces or of blood, when once formed have little tendency to diffuse themselves, but become localised in the neighbourhood of that part from which they were originally poured out, owing, in the first instance, to the surrounding pressure, and, at a later period, to the deposit of plastic matter between the folds of intestine and neighbouring viscera. In this way, the diffusion of irritating matters through the abdominal cavity being prevented, the likelihood of the occurrence of wide-spread and fatal inflammation is much diminished.

The existence of these extravasations may, in many cases, be recognised by dullness on percussion around the wound, by the localised swelling to which they give rise, and sometimes by their escape through the external aperture.

Treatment.—In the treatment of penetrating wounds of the abdomen, we must first consider the management of the injured parts; and, afterwards, the prevention or cure of the consecutive peritonitis.

If the wound have not implicated any of the abdominal viscera, it must be closed by relaxing the abdominal muscles by position, by introducing a few points of suture through the integuments, if it be extensive, and by applying a compress and plaster, supported by a bandage. The patient should then have a full dose of opium given him; about two grains of solid opium or forty minims of the liquor sedativus, which must be repeated in from four to six hours, so that the effects may be kept up. I prefer the solid opium in these cases, of which as much as from six to eight grains may be given in the twenty-four hours. He should then be kept perfectly quiet in bed, and no nourishment given for a few days, except barley-water and ice. The bowels should not be opened by aperient medicine, lest abdominal irritation be set up, but oleaginous enemata may be administered at the end of a week or ten days.

If the intestine be wounded but not protruding, we must endeavour to limit the peritonitis that will ensue, and also to prevent feculent extravasation. With this view, the patient should be laid on the injured side with the wound dependent, so as to allow the feces to escape through it, if disposed to do so. If the injury be about the umbilicus, he must lie upon his back with the knees drawn up and bent over a pillow. Opium must then be administered in the full doses already indicated, and repeated in grain doses at least every fourth or sixth hour, so that the system may be kept well under its influence. The value of opium in these cases is very great; it not only seems to moderate the inflammation that takes place in the peritoneum, but is of the greatest utility in preventing extravasation of feces. This it does by arresting the peristaltic movements of the intestine, and thus, by keeping it from change of position, lessening the chance of the escape of its contents. This arrest of the intestinal movements also tends greatly to the closure of the wound. Travers has shown experimentally, and his investigations have been confirmed by subsequent observations on the human subject, that

wounds of the intestines are closed by lymph that is thrown out, not only from the contiguous peritoneal surfaces of the part actually injured, but from that of neighbouring coils; so that the aperture in the gut becomes permanently glued and attached to the structures in its vicinity. In order that this process should take place, it is necessarily of the first importance that the movements of the bowel be paralysed; and it is a beautiful provision of nature that the very inflammation which closes the wound, arrests that peristaltic action, the continuance of which would interfere with its agglutination to, and closure by, the neighbouring parts. Until, therefore, the necessary degree of inflammation to effect this is set up, the intestinal movements must be arrested by opium.

If *extravasation of feculent matter* have taken place into the cavity of the abdomen, an attempt may be made to facilitate its escapes by removing the stitches and plasters from the external wound, and placing the patient on the injured side, so that this may be in the most dependent position; should the lips of the wound have already become adherent to one another, they may even be gently and carefully separated by the introduction of a probe, and in this way an outlet afforded for the effused matters.

When a *portion of intestine or of omentum has protruded*, it should be replaced as speedily as possible, before strangulation has occurred to occasion gangrene of the protruded mass. In order to effect reduction, the abdominal muscles should be relaxed by bending the thigh upon the abdomen, when the surgeon may gradually push back the protrusion by steady pressure upon it; no force must, however, be had recourse to, nor any rough handling of the exposed and delicate parts; but if it be found that their return cannot readily be effected, owing to the constriction of the neck of the tumour, the aperture through which they have escaped must be carefully enlarged in a direction upwards, by means of a probe-pointed bistoury, or a hernia-knife guided by a flat director. The incision necessary to enlarge the opening sufficiently to admit of reduction, need not exceed half-an-inch in length. In replacing the protruded parts, whether by the aid of incision or not, care must be taken that they are fairly put back into the cavity of the abdomen, and not pushed up into the sheath of the rectus, or into the subserous cellular tissue lying before the peritoneum; an accident that would be fatal, by allowing the constriction of the neck of the protrusion to continue unrelieved. In effecting the return, the surgeon should not push his finger into the cavity of the abdomen, but must content himself with simply replacing the protruded gut, or omentum, and allowing it to remain in the immediate neighbourhood of the wound in the abdominal wall, to which it will contract adhesions; and through which its contents may escape, in the event of any sloughing action being set up in it. If the protrusion be indurated, it must equally be replaced without delay; but should the intestine have become gangrenous from continued constriction and exposure, no attempt at reduction should be made, but an incision must be carried through it, so as to allow the escape of feces, and the formation of an artificial anus. If the protruded omentum be gangrenous, it must be excised on a level with the peritoneum, to the aperture in which that portion lying within the abdomen will have contracted adhesions.

If the intestine that protrudes be wounded, the treatment of the aperture in the gut will call for special attention; and surgeons have been somewhat divided as to the line of practice that should be pursued in such a case. The question that has been left open is, as to the propriety of stitching up the wound of the intestine. Scarpa and S. Cooper were opposed to this practice, on the ground that it does not prevent extravasation, and that the stitches

produce irritation by acting as foreign bodies. They proposed to return the wounded gut, taking care, however, to leave the aperture in it to correspond with that in the abdominal wall, so that an artificial anus might be established by the cohesion of the edges of the openings to one another, the adhesion preventing extravasation. To this practice the great objection exists, that extravasation will probably occur before there has been time for the effusion of lymph, and the agglutination of the contiguous surfaces, besides which, it is impossible to secure the necessary correspondence between the two apertures, the wounded gut being very liable to alter its position after it has been replaced. It has also been found by experience that one of the objections urged against the employment of a suture, that it cannot prevent the escape of feculent matter, is not valid. If it be properly applied, it may effectually do so, as was shown by a successful case under my care, the details of which were published in the *Lancet* for 1851. That the stitches act as sources of irritation to any serious extent is also doubtful. Travers found by experiment that, when a wounded gut was sewn up, and returned into the abdomen, the sutures quickly became bridged or coated over with a thick layer of lymph, and, gradually ulcerating their way inward, at last dropped into the cavity of the intestine, being discharged *per anum*, and leaving a firm cicatrix at the point to which they had been applied. For these various reasons, Guthrie, Travers, and other surgeons of experience, advocate the practice of stitching up the wound in a protruding intestine in suitable cases, with which opinion I entirely agree. It is, however, evident, that no positive and unvarying rule can be laid down that is applicable to all cases. Much must depend on the nature, causes, and extent of the wound in the gut. If it be very large and transverse, the result of gunshot violence or other contusing force, no suture can be of any service; for, not only might it be difficult to bring the edges together, but they would probably not cohere to one another, nor to the abdominal wall. If, however, the wound be a punctured or incised one, of moderate extent, the case is different. Much will also depend upon the way in which the sutures are applied. They should be introduced by means of a fine round needle, armed with sewing silk, in such a way that the peritoneal surfaces on each side of the wound alone are brought into contact, as adhesion takes place solely between them, the wound in the other structures of the gut filling up by plastic deposit. It has been recommended that the needle should penetrate the peritoneal and cellular coats only,



Fig 144. Application of Suture to Wounded Bowel.

no muscular tissue being taken up in it, lest retraction of the included fibres, by dragging upon the stitches, might re-open the wound. This advice, however, it is extremely difficult to follow. The safer plan is doubtless to carry the suture through the whole thickness of the gut, bringing the stitches out at about one-sixth of an inch from the edge of the cut, in such a way that the serous surfaces are drawn into apposition (Fig. 144). The kind of suture that should be used is the "glover's stitch." When the lips of the wound have been nearly brought into apposition in this way, it has been proposed to leave the end of the thread hanging out of the aperture of the

abdominal wall, and to withdraw it when it becomes loose, but I think a

better not to leave it, as it might induce great irritation, acting like a seton in the peritoneal cavity. The ends, therefore, should be cut short close to the knot, when the suture will eventually become covered with lymph, and find its way into the inside of the gut by ulcerating through the muscular and mucous coats.

Should the aperture in it admit of being thus closed, the protruded portion of the intestine must be reduced, having previously been properly cleansed with a little lukewarm water. Should, however, the protruded gut be too extensively torn, and especially if it be lacerated by gun-shot injury, it would be useless to stitch it up, and it must be gently and carefully reduced. The reduction must be effected in the way that has already been described, the surgeon being especially careful not to push the wounded coil of intestine far into the abdomen, but to leave it close to the external orifice, so that, in the event of extravasation occurring, or the stitches giving way, a ready outlet may be afforded. Should the wound in the abdominal wall be extensive, it must be closed by means of sutures and plasters, supported by a bandage, the inferior angle being left open to allow of the escape of extravasation. The wound in the peritoneum had better be left; but should it be very extensive, the practice that was successfully adopted under such circumstances by Mr. Ward, of stitching up the aperture in it, might be had recourse to.

The after-treatment must be conducted in all respects on the same principles as in the case of an intestine wounded without protruding. Care must be taken, by attention to the position of the patient, and by the free administration of opium, to keep the bowel as quiet as possible near the external opening; the urine should be drawn off twice in the twenty-four hours, and no purgative whatever administered, lest, by the excitation of peristaltic action, adhesion be disturbed and extravasation take place. After the lapse of six or eight days an enema may be thrown up, and repeated from time to time. No food should be allowed for the first three days, during which time ice and barley-water should be freely taken; after this, beef-tea, and light food that leaves no solid residue, may be administered. It is of great importance that no solid food should be administered for at least two or three weeks after the occurrence of the injury. In a case of wound of the intestine which was under my care, the patient, who was progressing very favourably, and eventually recovered, nearly lost her life by eating the pulp of an orange on the tenth day.

TRAUMATIC PERITONITIS is the great danger to be apprehended in all these injuries of the abdomen, and it is by inducing this that extravasation of feces or of blood so frequently proves fatal. It is true that a certain degree of inflammation of the peritoneum is necessary for the healing of all abdominal wounds, but it must be limited in extent and plastic in character. It is the more diffuse form of peritonitis, attended by the exudation of turbid serum and shredly ill-conditioned lymph, that is so speedily fatal. In these cases, we meet with the ordinary symptoms of the idiopathic form of this affection; uniform tenderness about the abdomen, with much tympanitis, more particularly in the neighbourhood of the injury, with occasional stabbing pains, followed by tympanitic distension, vomiting, and hiccup, a small, quick, hard pulse, often assuming a wiry incompressible character, with considerable pyrexia, and great anxiety of countenance. The traumatic peritonitis will set in and run its course with great rapidity; in a case in University College Hospital, already alluded to, of bullet-wound of the abdomen, the patient lived twenty-four hours. Two or three parts of serous effusion with much puro-plastic matter were found; and great reddening of

the whole of the visceral and much of the parietal peritoneum had ensued. As the inflammatory extravasation increases, dullness on percussion will manifest itself—usually first on the flanks, and then gradually extending forward until it may occupy a great extent of surface in the abdomen.

In the *Treatment* of this disease, we must be guided by the character of the inflammation. If it be of a sthenic form, and the patient young and robust, he should be bled freely in the arm, and have leeches abundantly applied over the surface of the abdomen; a pill composed of two grains of calomel and one grain of opium may then be administered every sixth hour, or oftener if the patient be not influenced by the narcotic; and rigid abstinence from all except ice and barley-water should be enforced. If the peritonitis be the result of a wounded intestine, it is safer to omit the calomel, using mercurials instead to the inside of the thighs, but giving opium freely. When the peritonitis occurs in an old or feeble subject, our principal trust must be in the administration of opium and in free leeching of the abdomen, followed perhaps by a blister, which may be dressed with mercurial ointment. In these cases, however, early support will be required, with perhaps the administration of wine or stimulants. The inflammatory extravasation will gradually be absorbed under the influence of the calomel, aided by blisters.

INJURIES OF THE PELVIC VISCERA.

BLADDER.—*Rupture of the Bladder*, from blows upon the abdomen, is not of very unfrequent occurrence. It can scarcely happen when the organ is empty, as it then sinks down under cover of the pelvic bones. But when the bladder is greatly distended, rising high above the pubes, and thinned proportionately to its distension, it may very readily be ruptured, even by very slight degrees of external violence, as by one man rolling over another in a drunken scuffle, or by a person running against a post or falling out of bed.

The *Effects* of this injury vary considerably, according to the part that has given way or been wounded. If the laceration have occurred in those portions of the viscus that are invested by peritoneum, the urine will at once escape into the pelvic and abdominal cavities, and speedily occasion death by the intense irritation and inflammation set up by it. I have, however, seen a case in which, even under these circumstances, the patient survived ten days. If, on the other hand, that portion of the organ has been ruptured which is uncovered by the peritoneum, the urine may infiltrate into the cellular tissue between this membrane and the abdominal wall, and, diffusing itself widely, produce destructive sloughing of the tissues amongst which it spreads. In these cases life may be prolonged for some days, when the patient commonly sinks from the combined irritative and inflammatory action. An open wound of the bladder is by no means so dangerous as its subcutaneous rupture. Many patients have recovered whose bladders have been perforated and traversed by bullets, the urine finding a free exit through the apertures, and consequently not tending to extravasate itself. Guthrie relates several cases of this kind; and Dr. Thomson saw fourteen cases of this description after the battle of Waterloo, in a fair way of recovery. Thus, although we must look upon this accident as of the gravest character, yet it cannot be considered as being necessarily fatal.

The *Symptoms* of a ruptured bladder are sufficiently evident; the injury in the hypogastric region, followed by collapse, by intense burning pain in the abdomen and pelvis, with inability to pass the urine, or, if any have escaped from the urethra, its being tinged with blood, are usually sufficient

to point to the nature of the accident. If, in addition, it be found on introducing a catheter that the bladder is empty, or that but a small quantity of bloody urine escapes, the surgeon may be sure that this organ has been burst. In the case of gun-shot injury, the escape of urine, which generally takes place through the track of the bullet, will afford incontestable evidence of the mischief that has been produced.

In the *Treatment* of these cases, the most important indication is the prevention of further extravasation by the introduction of a full-sized elastic catheter into the bladder. This must be tied in, and should not be plugged, but should be left open, or with a vulcanised India-rubber tube attached, so that the urine may dribble away through it as fast as it accumulates. If any sign of extravasation make its appearance externally, free and deep incisions should be made into the part, so as to facilitate the early escape of the effused fluid and the putrid sloughs. I cannot but consider all active antiphlogistic treatment as out of place in these injuries, never having seen the slightest benefit from their employment. The only chance that the patient has, if once extensive extravasation have occurred, is that there may be sufficient power left in the constitution to throw out a barrier of lymph that will limit the diffuse and sloughing inflammatory action set up; and the prospect of this would certainly not be increased by the employment of depletory measures. There will also be so great a call upon the powers of the system at a later period, after sloughing has fairly set in, that a supporting or even stimulating plan of treatment will rather be required.

Foreign Bodies, such as pieces of catheters, tobacco-pipes, pencils, &c., are occasionally met with in the urinary organs, having been introduced through the urethra. In some cases they are soon spontaneously expelled, but more usually they require extraction; sometimes they may be fortunately seized with a small lithotrite or urethral forceps in the direction of their long axis, and thus extracted; but more frequently they require to be removed through an incision made into the bladder. This is more safely done by the median than by the lateral operation of cystotomy.

It occasionally happens that musket-balls, pieces of clothing, &c., have been lodged in the bladder in gun-shot wounds of that organ. These speedily become incrustated with urinary deposits, and, giving rise to the symptoms of stone in the bladder, require to be removed by cystotomy, an operation that has proved very successful in these cases, evidently in consequence of the healthy condition of the urinary organs. Mr. Dixon has collected from various works the details of fifteen cases, in which balls, that had either primarily entered the bladder, or had found their way into this organ by necrosis or ulceration after having been lodged in the neighbourhood, were extracted by operation. In ten of these cases the result was successful; in the remaining five no record is made of the termination.

Rupture of Ureter.—Mr. Stanley has related a remarkable case in which the Ureter was ruptured by external violence, and in which the patient recovered; a very large accumulation of fluid forming on the injured side of the abdomen, with considerable circumscribed tumefaction and fluctuation, and which required repeated tapping. In another case in which the *Pelvis of the Kidney* was ruptured, a similar collection of urine took place within the abdomen, requiring tapping; as much as six pints being removed at one sitting. On examination after death, which occurred on the tenth week from the accident, a large cyst was found behind the peritoneum, communicating with the pelvis of the kidney.

Wounds of the Organs of Generation in the male may be accidental, occasioned by sharp instruments or gun-shot, or may be self-inflicted. When

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In the *Treatment* of this disease, we must be guided by the character of the inflammation. If it be of a sthenic form, and the patient young and robust, he should be bled freely in the arm, and have leeches abundantly applied over the surface of the abdomen; a pill composed of two grains of calomel and one grain of opium may then be administered every sixth hour, or oftener if the patient be not influenced by the narcotic; and rigid abstinence from all except ice and barley-water should be enforced. If the peritonitis be the result of a wounded intestine, it is safer to omit the calomel, using mercurials instead to the inside of the thighs, but giving opium freely. When the peritonitis occurs in an old or feeble subject, our principal trust must be in the administration of opium and in free leeching of the abdomen, followed perhaps by a blister, which may be dressed with mercurial ointment. In these cases, however, early support will be required, with perhaps the administration of wine or stimulants. The inflammatory extravasation will gradually be absorbed under the influence of the calomel, aided by blisters.

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should be an elastic one, must be left in the bladder for a few days. It should not be plugged, but have a vulcanised India-rubber tube attached, for the urine readily to escape. If any hardness, throbbing, or other sign of irritation occur in the perineum, free incision should be made into the part, so as to afford a ready outlet for any urine that may have been effused. If the surgeon find it impossible to get a catheter into the bladder, the urethra being torn completely across, he should pass it as far as it will go, and then, putting the patient in the position for lithotomy, make a free incision in the mesial line, upon the point of the instrument, so as to make an opening in the perineum communicating with the deeper portion of the urethra; or he may puncture through the rectum if the bladder be distended; but it is best to get a free outlet for the urine through the perineum, if possible. As the urine becomes extravasated, the surgeon must follow its course with free and deep incisions, supporting the strength of the patient at the same time by a due allowance of stimulus and nourishment. If, when the urethra is completely torn across, the urine find a difficulty in escaping, and relief be not afforded by the perineal incision, the bladder becoming overdistended, this organ should be tapped through the rectum, in the way which will be described when we come to speak of diseases of the urinary organs.

VAGINA AND RECTUM.—*Foreign bodies* are occasionally thrust forcibly into or impacted in the vagina or rectum. When a foreign body, such as a stick, or a broom-handle, or the leg of a chair, is thrust forcibly up the rectum by a person falling on such a thing, two dangers may result; either extensive laceration of the sphincter and perineum, with hemorrhage; or transfixion of the gut and wound of the peritoneum, with consecutive inflammation of that membrane. The consequences of such an injury present nothing very special, and require to be treated on ordinary principles. If in the fall the foreign body have been forcibly thrust into the vagina, there will be danger of similar injury to the bladder or peritoneum; but the chief source of danger will result from laceration of the labium, and free hemorrhage from this source. I have several times seen enormous quantities of blood lost from such injuries. This hemorrhage is best arrested by plugging firmly with lint soaked in a solution of the perchloride of iron, and the pressure of a bandage. A variety of things, such as pieces of stick, glass bottles, gallipots, &c., have been introduced and impacted in these canals. Their extraction is often attended with great difficulty, in consequence of the swelling of the mucous membrane over and around them, and the depth to which they have been pushed. In order to remove them, lithotomy or necrosis forceps may be required. In some cases the foreign body has been found to transfix the wall of the canal in which it is lodged, and, by penetrating the peritoneum, has speedily occasioned the patient's death. A remarkable case of this kind occurred in my practice, in which a cedar pencil, five inches long, and cut to a point, had been forced up through the posterior wall of the vagina of a young woman into the abdominal cavity. Here it transfixed two coils of the small intestine, and, after a sojourn of eight months, was extracted by an incision through the anterior abdominal wall, midway between the umbilicus and Poupart's ligament, where its point was engaged in the fascia transversalis. It had occasioned repeated attacks of peritonitis; and, after its extraction, death resulted from that cause.

LACERATION OF THE PERINEUM.—The perineum is occasionally ruptured during parturition. The extent of the laceration necessarily varies greatly, and influences materially the ultimate issue of the case. In some cases there is merely a slight rent at the fourchette; in others the whole perineum has given way as far as the sphincter and; in a third class of cases the sphincter

is torn as well; and in a fourth set the rent has extended into the recto-vaginal septum. The worst cases are those in which the perineum has been torn, and the recto-vaginal septum destroyed by sloughing from prolonged impaction of the fetal head. In such cases the loss of soft tissues and the existence of dense cicatricial bands renders complete union by operation very problematical.

The length of time that has elapsed since the occurrence of the injury is of little consequence. It is as easy to repair a perineum that has been lacerated for ten years, as for ten days. A very serious evil arising from ruptured perineum is the loss of support to the pelvic viscera, and the consequent liability to prolapsus of the uterus or vaginal wall that results. When the sphincter or recto-vaginal septum has given way, incontinence of feces to a greater or lesser extent is the consequence, and the parts are from this cause liable to excoriation; and not unfrequently the rectal mucous membrane becomes prolapsed or hemorrhoidal.

The *Treatment*, which is purely operative, consists of a plastic procedure, having for its object the bringing together and the union by adhesion of the opposite sides of the rent. The extent and difficulty of this operation, and its prospect of success, will depend on attention to several points, but also, as is the case with most plastic procedures, on the state of the patient's health. This should be brought up to the best standard before the surgeon proceeds to operate, all local irritations should be removed, piles or prolapsus ani tied, and the parts brought into as healthy a state as possible. When the laceration is of limited extent and recent, union may usually be effected by bringing and keeping the thighs together immediately after its occurrence. Should the laceration not extend into the sphincter ani, it may usually readily be repaired by paring the edges freely, and passing two deep quilled and four superficial sutures, so as to bring the opposite sides together.

When the laceration is very extensive, extending through the perineum, the sphincter ani, and the posterior wall of the vagina into the rectum—in fact, tearing through the recto-vaginal septum, more energetic and careful treatment will be required. The following is the mode of performing the necessary operation.

The bowels having been well cleared out, and the patient being placed in the position for lithotomy, the edges and sides of the rent must be freely and deeply pared in a horse-shoe shape, so as to leave a raw surface about an inch in width. The greatest care must be taken to remove every particle of mucous membrane and integumental structure, not only from the sides of the fissure,



Fig. 144.—Treatment of Lacerated Perineum.

but also from above the upper angle of it, in the recto-vaginal septum, and from the anterior part of this. Any portion of these structures that may be left behind, however minute, is of course an obstacle to union, and will either interfere completely with it, or leave a fistulous opening in its site. The sphincter ani should then be freely divided on each side of the coccyx, as recommended by Mr. Brown, in order that its action may be paralysed and all tension of the part removed. Three points of quilled whipcord suture (Fig. 145) should then be passed deeply through the freshened

edges of the laceration, and the edges brought together by a few points of interrupted suture. The best material for these superficial sutures is the thin telegraph wire, covered with gutta serena. It is soft and perfectly unirritating. In the last case in which I operated, I applied it in the continuous manner by means of the glover's stitch, and found the parts much more securely and easily held together in this way than by the interrupted suture. The success of the operation will, to a great extent, depend on the attention bestowed on the after-treatment of the case, the mode of conducting which has been laid down with much precision by Mr. Brown. The principal points to be attended to are as follows. Immediately after the operation, a full dose of opium should be given, and a grain administered every sixth hour, with a view of arresting all intestinal action. The strength should be maintained by abundant nourishment. The patient should be laid on her side, and a catheter, furnished with a long India-rubber tube, retained so as to prevent any dribbling of urine over the raw edges, which would be fatal to their union. The deep sutures should be left in for three days, as a general rule. In some cases, they may even be retained for ninety-six hours; but, if any suppuration be set up along their track, they must at once be withdrawn. The superficial sutures should be left in as long as they produce no irritation; when of telegraph or ordinary wire, they may be left undisturbed for eight or ten days. During this period, I have found it advantageous to keep the part covered with collodion. When the sutures are removed, a pad of dry lint, supported by a T-bandage, should be applied. The bowels should not be allowed to act for at least ten or twelve days, lest the freshly united surfaces be torn through. During the whole of this period, the patient's strength must be supported by good diet, and scrupulous attention paid to the cleanliness of the parts. Plastic operations of this kind should not be performed unless the patient is in a good state of health, that there may be a good prospect of immediate union.

The success of the case will at last mainly depend on the extent of laceration, or rather of loss of substance, in the recto-vaginal septum. If this be un injured, or merely notched as it were, but little difficulty will be experienced in effecting a cure. If, on the other hand, this wall be deeply lacerated, or, still worse, if a portion of it have sloughed away, the greatest difficulty may result in effecting union; and under such untoward circumstances it may happen, that the perineum unites, but that a fistulous opening is still left in the recto-vaginal wall, requiring a future plastic operation for its closure (*vide* Chapter XLII.).

DIVISION THIRD.

SURGICAL DISEASES.

CHAPTER XXVIII.

ABSCESS.

AN *Abscess* signifies a collection of pus occurring in any of the tissues or organs of the body. In structure, an abscess consists of an accumulation of pus situated in the midst of, and surrounded on all sides by, a layer of fibrine deposited in and consolidating the neighbouring tissues. The lymph, which constitutes the wall of the abscess, varies greatly in thickness and consistence; in some cases being scarcely perceptible, in others some lines in thickness and of corresponding firmness, constituting perhaps the principal part of the mass. This wall of "limiting fibrine" is always very vascular, in consequence of the inflammation and congestion of the tissues that enter into its composition. Outside it there is an infiltration of sero-plastic matter, and beyond this we reach the healthy tissue.

VARIETIES.—Surgeons divide abscesses into various kinds, according to the symptoms attending them, their duration, and their cause. Thus they speak habitually of *Acute* and *Chronic*, *Hot* and *Cold*, *Lymphatic*, *Diffuse*, *Metastatic*, and *Puerperal Abscesses*.

Acute or *Phlegmonous Abscess* may be taken as the type of the disease. When it is about to form, the part which has been previously inflamed swells considerably, with a throbbing pulsatile pain; the skin becomes shining, glazed, and of a somewhat purplish red. If the abscess be very deeply seated, the superimposed tissues become brawny and cedematous, without, perhaps, any other sign indicating the existence of pus. As the swelling approaches the surface, it softens at one part, where fluctuation becomes perceptible, and a bulging of the skin covering its summit takes place; this *pointing of the abscess* indicates that it is about to burst and discharge its contents, which it speedily will through a circular aperture formed in the skin. The *pointing* is an interesting pathological phenomenon, and takes place in the following way.

An abscess, perhaps originally formed deeply in the substance of a limb, enlarges by the extension of the periphery of its wall, and by the simultaneous degeneration into pus of the innermost layers of this structure. As the wall extends, it has a special tendency to approach a free surface, whether that be external or internal, skin or mucous membrane; all the tissues between it and the surface towards which it is progressing being gradually absorbed, or melting into the abscess. It is in this that the *pointing* essentially consists; and the mode in which it is finally accomplished would appear to be as follows. The pressure which the tumour exercises from within outwards causes compression of the vessels which, passing from the deeper

parts, ramify between the summit of the abscess and the superjacent skin for the supply of the latter. In consequence of this pressure upon the vessels and interference with the circulation through them, the nutrition of the parts supplied by them is arrested; and these become softened, disintegrated in structure, and less resistant to the progress of the tumour than those tissues which surround it on other sides, and which have not had their vascular supply interfered with, nor lost their normal cohesion. The abscess then naturally makes its way at this, the point of its circumference where it meets with least resistance. As it approaches the surface, the skin at first becomes more or less livid, tense, and oedematous, indicating the interference with its circulation; as the summit of the abscess presses upwards, the overlying skin loses its tension and becomes relaxed; it then sloughs at the most central point, from which the cuticle has previously peeled off, and, the outward pressure of the pus speedily detaching the slough, the abscess discharges itself. Though acute abscesses, if left to themselves, usually run this course and burst through the skin, the mucous or serous surfaces, or even into the interior of joints, yet some collections of pus, if very deeply seated, cannot find their way to the surface, but extend through the cellular planes of the limb in a lateral direction, burrowing and undermining the parts to a great extent; or, if situated in dense and unyielding structures, as in bone, are imprisoned within a case through which they may be unable to penetrate, in other rare instances, the pus becomes absorbed, and the abscess disappears. After an abscess has burst, the cavity usually closes by granulations springing up from within, and by the collapse of its walls; in some cases, however, it does not completely close, but contracts into a narrow canal, forming a sinus or fistula.

Chronic Abscesses are of very common occurrence. The tissue in the vicinity of a piece of dead bone being irritated by its presence, or a gland or some portion of the subcutaneous cellular tissue having become indurated, tender, or subacutely inflamed, at last, slowly and without any constitutional symptoms, or much appearance of local disturbance except the swelling, soften and break down into a somewhat thin, flaky, curdy puriform fluid, though in other instances the pus is perfectly healthy. These abscesses do not readily point, but often extend laterally, burrowing for a considerable distance from their original seat. In other cases they become circumscribed by a thick and dense wall of fibrine, through which it may be extremely difficult, and perhaps impossible, to detect fluctuation; the disease then simulating a solid tumour. The duration of these chronic abscesses without opening is often very remarkable, even when situated in soft parts. I have seen large chronic abscesses, in the iliac fossa and groin, perfectly stationary for nearly two years. When situated in denser structures, as in the substance of the breast, the wall may become so dense as to resemble a cyst, and the disease will continue in the same state for a great length of time. In the bones, abscesses may exist for an indefinite period.

Cold, Lymphatic or Congestive Abscess occurs not unfrequently with but slight precursory local symptoms, and indeed not uncommonly without any at all. The patient, who has usually been cachectic, and has suffered some time from general debility, feels slight uneasiness in the groin, iliac fossa, or axilla, and finds suddenly a large fluctuating tumour in one of these situations; there is perhaps no pain in the part, and no discoloration of the skin, but the fluctuation is always very distinct, the limiting fibrine being in small quantity. On opening such an abscess as this, there will usually be a copious discharge of thin unhealthy pus, which, when examined under the microscope, will be found to contain ill-developed, withered cells; in some cases,

the contents appear to be a clear semi-transparent or oily-looking matter, probably sero-plastic effusion.

Diffuse Abscess forms rapidly in the cellular tissue, as the result of diffuse inflammation. There is no limiting fibrine, and hence the pus often spreads widely, producing extensive destruction of parts before it is discovered. A particular variety of this form of abscess is the *Puerperal*, occurring in women after parturition in various parts of the body, especially in the iliac fossa, in the cellular planes of the thigh or in the joints, and in the adipose tissue of the orbit, often destroying the globe of the eye. To these forms of the disease the *Metastatic Abscesses* are closely allied. They commonly occur in connection with phlebitis and pyæmia, are very numerous, and are met with in the substance of organs as well as the cellular tissue and joints. The last three species of abscess are varieties of the acute form.



Fig. 146.—Large Lumbar Abscess extending down the Leg.

Tympanitic or Emphysematous Abscess, which contains gas as well as pus, is occasionally met with in the neighbourhood of the mucous canals, chiefly at the anterior and lateral parts of the abdominal walls, and about the sacrum. Sometimes the communication with the intestine is very free; in other cases it is not so evident. These collections are often perfectly resonant on percussion, the air being above, the fluid below, and sometimes gurgling is very distinct in them.

SITUATION, SIZE, &c.—Abscesses are met with in all regions of the body, but more especially where the cellular tissue is abundant, and the absorbent glands are numerous. They may occur at any period of life, from the earliest infancy to old age. I have opened a very large abscess in the axilla of a child about a fortnight old. Their size varies from that of a pin's point to a tumour containing a pint or more of pus. In some cases, when very large, they are *multilocular*, the different cysts being connected by narrow channels of communication; in this way I have seen a large abscess extending from the lumbar vertebra through the iliac fossa down the thigh, the ham, and the leg, until at last it was opened by the side of the tendo Achillis, forming five or six distinct cysts, communicating with

one another by contracted channels (Fig. 146).

EFFECTS.—The pressure-effects of an abscess are often important. By compressing the nerves of a part, it may give rise to very severe pain and spasm at a distance from its seat; and in this way, in some apparently neuralgic affections, it has turned out that the pain has been occasioned by the pressure of an abscess on the trunk of a neighbouring nerve. When blood-vessels come into relation with an abscess, they usually become coated by a thick layer of

lymph, which guards them from injury. In some cases, however, they become obliterated by the conjoined effects of the pressure and the inflammation, in which they as well as the adjacent tissues partake. In other cases, more particularly in strumous and cachectic individuals, the bloodvessels, not having been guarded by the protecting lymph, have ulcerated and burst into the cyst of the abscess, occasioning sudden and dangerous or even fatal hemorrhage. It is seldom, however, that a large artery or vein pours its contents into an abscess that has not been opened. These occurrences have chiefly taken place in the neck, in which situation both the carotid artery, as in a case described by Liston, and the internal jugular vein have opened into the cyst of an abscess. The various mucous canals, especially the trachea and the urethra, may be injuriously compressed by neighbouring abscesses; so also bones may become necrosed, and joints inflamed and destroyed, from the same cause.

DIAGNOSIS.—The diagnosis of abscess, though usually easily made, at times requires attention. The surgeon believes that an acute abscess is about to form when, after rigors and some modification of the inflammatory fever, he finds the local signs characteristic of the formation of pus; more especially a throbbing pain in the part, with softening of any induration that may have existed, and œdema of the cellular tissue covering it. His suspicion is turned into certainty, and he knows that an abscess has formed, when, after the occurrence of these symptoms, fluctuation can be felt, and the other signs manifest themselves. The fluctuation may, however, readily be confounded with the undulatory sensation communicated by some tissues from the mere infiltration of sero-plastic fluid into them, or even without this, from their natural laxity, as is sometimes the case in the cellular tissue of the testes and thigh in persons of lymphatic temperament. This, indeed, is a difference of degree rather than of kind; as pus would make its appearance in the course of a few hours, if the tumour were left to itself. The mere occurrence of fluctuation, however, is not of itself sufficient to determine more than that a fluid exists in the part. The question necessarily arises, Is this fluid pus? In the majority of instances, the history of the case, the character of the pain, the previous existence and the continuance of symptoms of inflammation, enable the surgeon to answer in the affirmative. But if there be obscure evidence only of inflammation having existed, and if the swelling be of long standing, the fluctuation being perhaps deeply seated and indistinct, the safer plan will be for the surgeon to introduce an exploring needle, and to see what the true nature of the fluid is; by this simple means many embarrassing mistakes in diagnosis may be avoided.

The tumours with which abscesses may be confounded, are those *soft solid growths* in which there is a high degree of elasticity, giving rise to a species of undulation, as in some kinds of encephaloid tumour; so also *fluid tumours* of various kinds, such as cysts and enlarged bursæ, may be confounded with abscess. In these cases the previous symptoms, the situation, and the



Fig 147.—Suction Trochar

general appearance and feel of the tumour, will usually enable the surgeon to effect a ready diagnosis, but should any doubt exist, the exploring needle

or trochar must be introduced, when, if pus be present, a drop or two will escape. Coxeter's "suction-trochar" (Fig. 147) is of especial service in cases in which it is desirable to withdraw some of the contained fluid for closer examination. The diagnosis of an abscess having pulsation communicated to it by a subjacent artery, from an *aneurism*, will be discussed when we come to speak of that disease. It may be well to mention that the pains occasioned by the pressure of some forms of chronic abscess upon neighbouring nerves have been mistaken for rheumatism or neuralgia.

PROGNOSIS.—Abscesses vary greatly in danger, according to their nature, size, situation, and cause, and the constitution of the patient. The chronic form is usually attended by more risk than the acute and the diffuse. The puerperal and pyemic are especially hazardous to life, being generally associated with a bad state of the blood. The large size of some abscesses is an element of great risk, occasioning not only a very abundant discharge of pus, but likewise great constitutional irritation when they are opened. Abscesses that are situated in the neighbourhood of important organs, as about the neck of the bladder, or in the anterior mediastinum, are necessarily much more hazardous from the peculiarity of their situation than those which are met with in less important regions. The cause of the abscess also influences the result; if it be a piece of dead bone that can be removed, the discharge will speedily cease on its being taken away, but if it be so situated that it cannot be got rid of, it will, by acting as a continuous source of irritation, keep up a discharge that may eventually prove fatal. The constitution of the patient influences our prognosis. Such an amount of discharge as would inevitably prove fatal in a cachectic system, may influence a sound one but very little; so also, the wasting effect of an abscess is better borne about the middle than at either of the extreme periods of life.

TREATMENT.—The treatment of abscess presents three points requiring attention. The first object should be to prevent the formation of matter; the next to take steps for its evacuation when formed; and the last, to endeavour to close the cavity that results.

In order to prevent the formation of matter, it is necessary to get rid of any local irritant that may exist; thus dead bone should be removed, or extravasated urine let out of the cellular tissue. After this has been done, the preventive treatment must consist in the active employment of local antiphlogistic means, such as leeches and cold evaporating lotions: any slight tenderness that continues after the inflammation has subsided must be removed, and the swelling from exudation-matter, which is especially the precursor of chronic abscess, must be got rid of by the continuous application of some discutient lotion. One composed of iodide of potassium, ℥i., spirits of wine, ℥i., water, ℥vij., is extremely useful; in some cases absorption may advantageously be promoted by mercurial ointments or plasters. When once pus has formed, it is a question whether it can be absorbed again; in general, it certainly cannot, more especially if once a distinct cyst have formed around it, but in some cases it may undergo absorption; thus, in hypopium, we occasionally observe that the pus deposited in the anterior chamber of the eye is removed; and I think it probable that the same may happen when it is infiltrated into the tissues of a part, without a very distinct wall surrounding it. The more fluid parts of chronic abscesses occasionally become absorbed, leaving a cheesy residue, which may degenerate into cretaceous matter.

When, notwithstanding the employment of antiphlogistic means, it is evident that pus is about to form, the treatment should be completely changed, and, by the aid of warmth and poultices, an endeavour should be made to

hasten suppuration. When this is fully established, the abscess having become "ripe," steps must be taken for the *evacuation of the matter*. The treatment of acute and of chronic abscesses differs essentially in this respect.

In the *acute abscess*, the matter should be let out as soon as it is fully formed, especially in those varieties of the disease connected with a morbid state of the system, as in the metastatic and puerperal forms. When this is done, the constitution at once experiences great relief, the fever and general irritation subsiding materially; the free incision not only letting out the pus and lymph, but removing tension, and, by encouraging local bleeding, lessening the inflammatory action. The rule of opening an acute abscess early is especially imperative when the pus is formed in the sheaths of the tendons and under fibrous expansions, as in the palm of the hand; also when it is situated deeply in the cellular planes of a limb, under the larger muscles, where it has a tendency to diffuse itself extensively. In those cases, likewise, in which pus is lodged in close proximity to a joint or under the pericæum, it must be let out early; so also, when it presses upon mucous canals or important organs, as on the urethra or trachea, or when it is dependent on the infiltration of an irritant fluid into a part, as in urinary extravasation, it must be evacuated without delay. The pus should always be let out early, before the skin covering it is thinned, when the abscess is situated in the neck or in any other part where it is desirable that there should be as little scarring as possible.

In *chronic abscess*, the rule of surgery is not so explicit. Here the collection is often large, coming on without any very evident symptoms and giving rise to no material inconvenience; but, if it be opened, putrefaction of the pus, consequent upon the entry of air into the extensive cyst, will give rise to the most serious constitutional disturbance, setting up irritative fever that may rapidly prove fatal in a debilitated frame; and, should the patient escape this danger, the drain of an abundant suppuration may speedily waste him. Hence, it not uncommonly happens that a patient may carry a chronic abscess unopened, without any very serious disturbance, for many months or even years; but when it is once opened, he dies in a few days. If, however, the chronic abscess be so small that no danger is to be apprehended from the inflammation of its cyst, or if it be situated in parts where it may give rise to dangerous pressure, the matter should be let out without delay.

There are three modes by which abscesses may be opened, each of which possesses advantages in particular cases;—these are *Incision*, *Tapping with a trochar*, and making an aperture into the cyst with *Caustic*.

Incision is the only plan that should be practised in acute abscesses. For this purpose a lancet, an abscess-bistoury (Fig. 148), or a sickle-shaped

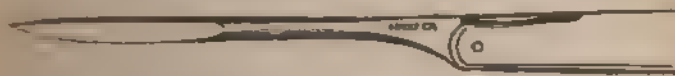


Fig. 148.—Abscess Bistoury.

knife, may be used. The incision should be made either at the point where fluctuation is most distinct, or at the most dependent part of the tumour, so as to prevent after bagging of the matter. It should be made by holding the bistoury or lancet short, and introducing it perpendicularly into the affected part. If the depth to be reached is considerable, a bistoury should be used, the blade of which should be half turned round after its introduction, when the pus wells up by its side, the point being felt to move freely

in the cavity of the abscess. The incision must then be continued for a moderate extent in the direction of the natural folds of the skin of the part, or in the course of the vessels. The pus should be let out freely, so as to allow the walls of the abscess to collapse, but it should not be forced out by squeezing the sac.

It may happen, after the escape of the pus, that the cavity of the abscess fills with blood by the rupture of some small vessel situated in its wall; this, however, is of little moment, the hemorrhage speedily ceasing on the application of pressure, of a bandage, or of cold.

Provided the incision have only to be carried through the integumental structures and fascia, in order to afford an outlet for the pus, there can be but little danger of hemorrhage from the accidental wound of any bloodvessel of importance; and, should bleeding occur, it will probably be of a venous character, and may be arrested by pressure and position. But when the abscess is more deeply seated than this, lying under the superficial muscle, where it will then be necessary to penetrate, more serious consequences may ensue, and the incautious use of the knife may lead to the most perilous results. This is more particularly apt to happen in deeply seated perforating abscesses of the thigh; and I have more than once known such profuse arterial hemorrhage follow incisions made for the purpose of evacuating pus deeply lodged in the limb in these cases, as to necessitate the ligature of the femoral artery. In order to avoid this danger, Mr. Hilton has advised that abscesses so situated should be opened in the following way. An incision is made through the integuments and fascia so as to expose the muscle under which the pus lies; a director is then pushed through the substance of the muscle into the cavity of the abscess, and along the groove of this as a guide a slender pair of dissecting forceps is pushed: when they reach the abscess the blades are opened up, the muscular fibres separated, and free exit given to the pus.

After the opening has been made, a poultice or water-dressing must be applied; the cavity left eventually fills up either by the coalescence of its sides, or by granulating from below; if it fill again with pus, a fresh incision, termed a "counter-opening," must be made in the most dependent part. Nothing is more dangerous than *pent-up* matter in imperfectly opened abscesses. It speedily decomposes and becomes offensive, gives rise to local irritation and inflammation, and predisposes to the occurrence of erysipelas and pyemia. Free openings in dependent situations, and the use of the drainage-tube, must be had recourse to in order to prevent these evil consequences.

In the treatment of chronic and cold abscess, any one of these three plans may be employed for opening the sac. If it be of small size, an incision should be made into it at once. If the collection be considerable, we must wait until an opening has been rendered necessary by the tendency to implication of the skin, or by injurious pressure being exercised on important parts; the pus should then be let out by the valvular aperture recommended by Abernethy, the object being to limit the entry of air into the interior of the abscess, so as to lessen the chance of putrefaction of any pus that is left, and of consecutive inflammation of the cyst. The valvular opening is made by drawing the skin covering the abscess well to one side, then passing the bistoury directly into the sac, and allowing as much of the pus to escape as will flow out by the collapse of the walls of the abscess; before the matter has quite ceased to flow, and consequently before any air can have entered the sac, the skin should be allowed to recover its natural position, so that the aperture in it and in the cyst may no longer directly communicate. A

piece of plaster, or of lint soaked in collodion, should be placed upon the external wound, which will probably heal under this covering in the course of a short time. When the cyst of the abscess has again filled somewhat, this process may be repeated; and, less and less pus being allowed to accumulate in it before each succeeding evacuation, it may gradually contract and close.

Instead of making the valvular opening in this way, a chronic abscess may sometimes be advantageously opened by *Tapping with a Trochar and Cannula* of moderate size, the instrument being introduced obliquely between the skin and the abscess, and then made to dip down into the sac. After the withdrawal of the cannula, the aperture may be closed as in the former case. There is, however, one disadvantage in this plan of opening abscesses, that, if the discharge be curdy or shreddy, it is very apt to block up the cannula, and thus to interfere with the proper evacuation of the matter.

Potassa Fusa, though a painful application, may be advantageously used for opening these chronic abscesses, the skin covering which is much undermined, congested, and discoloured. In these cases I commonly employ it with great advantage. It is also useful in the after-treatment, when much solid plastic matter is left, dissolving this away by exciting inflammation around it, and thus preventing the formation of sinuses which are otherwise apt to occur.

In some forms of abscess it will be found that those processes which are necessary for the contraction and closure of the cyst, after its contents have been evacuated, do not readily take place; and it becomes necessary to have recourse to other measures, in order to excite sufficient healthy inflammatory action, to occasion the deposition of that plastic matter by which the cavity is filled. With this view, a seton of two or three threads may very usefully be passed across the cyst by means of a *newus-needle*, or by a long straight needle pushed up through the cannula used for tapping (Fig. 149). It



FIG. 149. Introduction of Seton through Cannula.

should be left in for a few days, by which time healthy inflammation will be set up. In other cases again, after the cyst has been tapped, the red wash or some tincture of iodine should be injected and left in. These methods of exciting inflammation are especially useful when the cyst is thin, and of a very chronic character. When the walls are very thick and dense, as sometimes happens in abscesses of very old standing situated in the neck, an elliptical piece of the anterior portion of the cyst should be dissected out, and the remainder of the cavity be lightly dressed with lint, and allowed to heal by granulation. This plan of treatment is often very successful; and I have by it cured abscesses in the neck of seven or eight years' standing, which have resisted every other plan employed.

M. CHASSAGNIAC has recommended the employment of *Drainage-tubes* in the treatment of chronic abscesses of large size. This method, which has been advantageously employed by many surgeons in this country of late

years, is practised in the following way. The abscess having been punctured, a small India-rubber tube, one-sixth of an inch in diameter, having several side holes punched in it, is passed into the cavity, one end being allowed to hang out for the pus to drain away. These tubes may very conveniently be introduced by being fixed on to the end of a forked probe (Figs. 150, 151,



Fig. 150.—
Forked Probe
for introducing
Drainage
tube.



Fig. 151.—
Drainage tube
for use with
Forked
Probe.

by which the tube is carried into the abscess and left there on the withdrawal of the probe. Another plan consists in passing the perforated India-rubber tube completely across the abscess, drawing it out through a counter-opening, and tying the two ends together. By this contrivance the pus is carried off by the side of rather than through the tube as quickly as it is secreted, the walls of the abscess collapse, and, as gradual closure takes place, the tube may be withdrawn. In some cases the drainage-tubes have appeared to me to act in another way than by merely removing the purulent secretion; viz., by irritating the wall of the abscess just as a seton would, and thus setting up increased activity, and materially augmenting the discharge. On their withdrawal, however, this stimulation has been found to be beneficial, causing a speedier closure of the suppurating cyst.

The *Constitutional Treatment* of abscess must be conducted on the general principles laid down in discussing the management of suppurative inflammation (p. 90). It must be borne in mind that, as abscess is always a disease of debility, a tonic and stimulant plan will early be required.

SINUS AND FISTULA.—After an abscess has been opened, its cavity may not fill up completely, but, contracting into a narrow suppurating track, may form a canal without disposition to close, and from which a small quantity of pus constantly exudes, thus constituting a *Sinus* or *Fistula*.

The *Causes* of this non-closure of the cyst of an abscess may be referred to the following heads:—1. The presence of a foreign body, as of a piece of dead bone at the bottom; 2. The passage of irritating secretions, as of urine, feces, saliva, &c., through the abscess; and 3. The contraction of neighbouring muscles; as when the abscess is in the neighbourhood of the sphincter ani, and as occasionally happens in abscesses about the limbs.

Structure.—A sinus or fistula consists of a narrow channel, often long and winding, having an external orifice usually somewhat protuberant, being situated under or among loose florid granulations. The walls of this channel, which are always indurated, are lined by a structure resembling mucous membrane; this, however, it is not, but simply consists of a layer of imperfectly formed granulations, exuding ichorous pus. If the orifice be occluded, this pus will collect within the sinus, and, distending its walls, reconvert it into an abscess. In structure, therefore, a sinus or fistula may be said to be a long, narrow, chronic abscess, with a permanent external aperture.

The *Treatment* of a sinus or fistula has reference to its cause in the first instance; for, until the foreign body that keeps it open and maintains the discharge is removed, it will be useless to attempt its closure. After its removal, we may endeavour to procure obliteration of the sinus by one of three methods.

1. *Pressure*, by means of a roller and graduated compress, so as to cause an agglutination of its opposite sides, is useful in those cases in which the

sinus is recent, without much surrounding induration, and so situated, as upon the trunk, that pressure can easily be applied.

2 A more healthy inflammation may often usefully be excited in the sinus, by injecting it from time to time with red wash or with tincture of iodine, by passing the threads of a seton through it, or by stimulating it by the occasional contact of a red-hot iron. My colleague, Mr. Marshall, has invented a very ingenious and useful apparatus, by means of which a platinum wire, introduced cold, is heated red-hot by the galvanic current. This plan of treatment, which is fully detailed in a paper published in the *Medico-Chirurgical Transactions* for 1851, has frequently been employed with much success in the University College Hospital in the treatment of fistulae and sinuses, to which other methods were not very applicable.

3 The last method consists in laying open the sinus from end to end, and then dressing the wound so that it may heal from the bottom; in this way neighbouring muscles, that have kept it open by their contractions, may also be set at rest. The division of the sinus should be made with a probe-pointed bistoury, introduced through the external opening either by the aid of a director or without such assistance. The operation should be done effectually, the sinus being usually followed as far as is prudent, and laid completely open.

CHAPTER XXIX.

ULCERS.

Various forms of ulcer, affecting the cutaneous surface or mucous membrane, are familiar to the practical surgeon. When occurring in the skin, as the result of non-specific disease, they may be arranged under the following heads: the Healthy; the Weak; the Indolent; the Irritable; the Inflamed; the Phagedenic or Sloughing; the Varicose; and the Hemorrhagic. Besides these varieties, each of which is marked by distinct characteristics, various other forms of ulceration depending on specific causes, as the Syphilitic, Scrofulous, Lupoid, Cancerous, &c., are met with; all of which will be treated under their respective chapters.

The varieties presented by ulcers are by no means dependent on local conditions merely, though these influence them greatly, but are in a great measure owing to constitutional causes. Indeed, the aspect of the ulcer, and the character of its granulations and of its discharge, are excellent indications of the state of health and of the general condition of the patient, as well as of the local disease.

Ulcers may be situated upon any part of the cutaneous surface as the result of violence; most commonly, when they occur from disease of non-specific character they are seated on the leg, but when arising from some specific affection they occur in particular situations, as on the penis, lips, tongue, &c.

HEALTHY OR PERULENT ULCER.—This may be considered the type of the disease. It presents a circular or oval surface, slightly depressed, thickly studded with small granulations exuding laudable pus, and having a natural tendency to contract and heal. It is the object of all our treatment to bring the other forms of ulcer into this condition.

Treatment.—In the management of the healthy ulcer, the treatment should

be as simple as possible ; water-dressing and the pressure of a bandage usually enabling it readily to cicatrise.

WEAK ULCER not uncommonly occurs from emollient applications having been continued for too long a time in the last variety of the disease, the granulations then becoming high and flabby, with a semi-transparent appearance about them, and sometimes rising in large, exuberant, gelatinous, reddish-looking masses above the surface of the sore. These high granulations have a feeble vitality, and readily slough.

The *Treatment* of this form of ulcer consists in keeping the part elevated and carefully bandaged, and applying an astringent dressing to the sore, such as a weak solution of the sulphate of zinc or of copper, or the "red-wash," according to the following formula :—Sulphate of zinc, grs. xvj. ; compound tincture of lavender and spirits of rosemary, of each ʒij ; water, ʒiij. This will be found a most useful application ; and the granulations may be touched from time to time with nitrate of silver.

INDOLENT ULCER.—This is always of a very chronic character. It is situated upon the outer side of the lower extremity, between the ankle and calf, and most frequently occurs in men about the middle period in life. It is deep and excavated, with a flat surface, covered by irregular and badly formed granulations, exuding a thin and sanious pus, having hard, elevated, and callous edges, and presenting generally an irregular and rugged look. The surrounding integument is congested, and matted to the subjacent parts ; there is usually very little subcutaneous cellular tissue about it, the skin being firmly fixed to the subjacent fascia ; and it would appear as if it were in consequence of this want of a vascular substratum from which to spring, that granulations do not readily arise. There is no pain attending this ulcer, and its surface, which often attains a very large size, may usually be touched without the patient feeling it.

Treatment.—The principle of the treatment here is twofold ; to depress the edge, and to elevate the base of the sore. This is effected by pressure and stimulation conjoined. The treatment should be commenced by rubbing the surface of the ulcer and the surrounding congested integument with nitrate of silver ; a linseed-meal poultice should then be applied for twenty-four hours, after which the sore should be properly strapped on the plan recommended by Baynton. The best plaster for this purpose is the *emplastrum saponis*, to which some of the *emplastrum resinae* is added to make it sufficiently adhesive ; this, spread upon calico, should be cut into strips sixteen or eighteen inches in length, and about an inch-and-a-half in width ; the centre of the strip should then be laid smoothly on the side of the limb opposite to the sore, and the ends, being brought forward, are to be crossed obliquely over it. Strip after strip must be applied in this way, until the limb is covered for a distance of a couple of inches above and below the ulcer. If the sore be near the ankle, this joint should be included in the strapping. Each strip of plaster should be applied with an equal degree of pressure, which may often be considerable, and it should cover at least one-third of the preceding strap ; the limb must then be carefully bandaged from the toes to the knee. Under this plan of treatment, the edges will subside, the surface of the sore will become florid, and granulations yielding abundant discharge will speedily spring up. Much of its success will depend upon the close attention that is paid to the case. If the skin be irritable, no resin-plaster should be used, but merely the soap or lead ; and the plasters should be changed at least every forty eight hours. If the discharge be very abundant, small holes should be cut in the strips to allow it to escape. When by this plan of treatment the edges of the sore have been

brought down, and the granulations sufficiently stimulated, an astringent lotion with bandaging may advantageously be substituted for the plasters. In some of these cases, I have found benefit from the internal administration of liquor arsenicalis.

INHERITABLE ULCER is mostly met with in women about the middle period of life, especially in those of a nervous and bilious temperament. It is usually of small size, and situated about the ankles, or upon the shin. Its edges are irregular, but not elevated; the surface is greyish, covered with a thin slough, and secreting unhealthy sanious pus. Its principal characteristic is the excessive pain accompanying it, which often, by preventing sleep, disturbs seriously the general health.

In the *Treatment* of this ulcer, we must attend to the constitutional as well as to the local condition. The patient should be put upon an alterative course of medicine, with aloetic purgatives, and some sedative at bedtime to procure rest. The mode of topical medication which I have found to succeed best, is to brush the surface of the sore and the surrounding parts from time to time with a strong solution of nitrate of silver, and then to keep emollient and sedative applications to it, such as lead and opium lotions. The occasional application of the nitrate of silver deadens materially the sensibility of the sore, and assists its granulation.

INFLAMED ULCER.—This is characterised by much redness, heat, and swelling of the surrounding parts, with a thick and offensive discharge, often streaked with blood; it may arise from the over-stimulation of one of the other varieties.

The *Treatment* must be locally and generally antiphlogistic. The elevated position, the application of leeches around the sore, and of cold evaporating lotions to the surface of the limb, speedily subdue the inflammatory action; and the healing process then takes place with great rapidity.

STATIONING ULCER.—When not specific, this is an increased degree of the inflamed variety, usually occurring in a feeble or cachectic constitution, and generally accompanied by a good deal of irritative fever. An angry dusky red bluish forms about the sore, which becomes hot and painful; the surface assumes a greyish sloughy look, the edges are sharp cut, and the ulcerative action extends rapidly.

Treatment.—This should consist in improving the general health by lessening irritation, and keeping up tone. The administration of opiates, with nourishing but unstimulating diet, should be trusted to at the same time that the local action is subdued by rest and warm opiate lotions. When the inflammatory condition has subsided, tonics should be given internally, and a grain or two of the sulphate of copper or of zinc may be added to the lotion with which the sore is dressed.

The specific varieties of sloughing ulcer will be considered in the chapters on Hospital Gangrene, &c.

VARICOSE ULCER derives its chief characteristic from being complicated with, or dependent upon, a varicose condition of the veins of the leg. In this affection of the venous trunks the skin gradually undergoes degeneration, becoming rawny, of a purplish brown colour, and being traversed in all directions by enlarged and tortuous cutaneous veins. The ulcer forms at one of these congested spots, by the breaking down of the already disorganised and softened tissue, forming a small irregular chasm of an unhealthy appearance, and varying much in character, being sometimes inflamed, at others irritable or sloughy, and then becoming indolent. One of the most serious effects of this ulcer is that, by penetrating into one of the dilated veins, it occasionally gives rise to very abundant hemorrhage; the

patient, in the course of a few seconds, losing a pint or two of blood. The hemorrhage may be readily arrested by laying the patient on his back, elevating the limb, and compressing the bleeding point with a pledget of wool and a roller.

The Treatment of a varicose ulcer must have special reference to the condition of the veins that occasions it; no local applications having much effect unless the pressure of the column of blood in the dilated vessels be taken off the part. This may be done by means of a well-applied bandage, made of elastic material, or a laced or elastic stocking applied to the leg, so as to keep up uniform pressure upon the distended vessels. In some cases, the length of the column of blood may be broken by the application of a vulcanised India-rubber band below the knee. In many cases, the cicatrisation of the ulcer cannot be brought about in this way; or, if it heal, it will constantly break open again: or hemorrhage may have occurred from a ruptured vein upon its surface: means, which will be described in a future chapter, must then be taken for the permanent occlusion of the varicose vessels by ligature. As this procedure, however, is attended by some danger from the occasional induction of phlebitis or erysipelas, it should not be had recourse to unless the existence of one or other of the conditions just mentioned urgently call for it.

HEMORRHAGIC ULCER.—This is a dark purplish-looking sore, occurring in women suffering from amenorrhea, and having a special tendency, whence its name, to ooze blood about the menstrual periods. It usually partakes of the character of the irritable ulcer.

Treatment.—The hemorrhagic ulcer requires to be treated by constitutional means, having for their object the improvement of the patient's general health, with this view, the preparations of iron and of aloes are especially useful.

ULCERS ON MUCOUS MEMBRANES—Various forms of ulcer occur upon the mucous membrane of the throat, rectum, and genital organs. As these, however, are commonly of a specific character, they will be hereafter described.

When ulcers of the mucous membrane are not of a specific character, they present the general appearances characteristic of the cutaneous, healthy, inflamed, or weak varieties, and require the topical applications which have been described as suited to these conditions; though generally they will bear and require the free employment of caustics, especially of the nitrate of silver.

CHAPTER XXX.

MORTIFICATION, OR GANGRENE.

THE local death of a part of the body, in surgical language, is termed *Mortification* or *Gangrene*. When the morbid action is confined to the osseous structures or to the cartilages, it is termed *Necrosis*; when limited to the soft tissues of a limb, *Sphacelus*; and when accompanied by ulceration, it is called *Slough*. Many other varieties of gangrene are recognised by surgeons. Like all other diseases, it may be *Acute* or *Chronic* in its duration; as the parts affected are moist and swollen, or dry and shrivelled, it may be divided into the *Moist* and the *Dry* or *Mummified* gangrene, so again, according to its cause, it is spoken of as *Idiopathic* or *Traumatic*; and very frequently, and most correctly perhaps, it is arranged under the denominations of *Constitutional* and *Local*, without reference to the com-

paratively accidental circumstances of its dryness or moisture. Besides these, various *Specific* forms of the disease are met with, which will require special consideration.

LOCAL SIGNS.—Whatever form the gangrene may assume, there are certain local phenomena that are common to all the varieties of it. There is complete loss of sensibility and of motion in the part affected; the temperature of which falls considerably below that of the body generally, giving rise to a sensation of damp and clammy coldness; and after a time there is an odour of putrescence evolved, very commonly with an emphysematous crackling from effusion of gas into the tissues of the part. The colour of the part affected is usually of a dark purplish or greenish black, more or less mottled with red. Thus, which is unlike anything else in the system, shows that putrefactive changes have taken place in the solids and fluids of the diseased tissues, and is usually connected with the moist and swollen form of the disease. In the dry variety of gangrene the colour is often at first of a pale tallowy-white, with a mottled appearance upon the surface. The skin soon shrivels, becomes dry, horny, and semi-transparent, and eventually assumes a brown wrinkled appearance; in other cases the gangrened part is brown, dry, and shrivelled from the very first. These differences in the colour of the mortified part indicate corresponding differences in the cause of the affection. In general terms, it may be stated that the dark varieties of gangrene are the result of destructive changes taking place in the very part itself, or are of constitutional origin; whilst the pale form of the affection occurs as a consequence of some obstruction in the supply of blood to the part, and is a local disease, influencing the constitution secondarily. But it must be borne in mind that gangrene may have occurred, that is to say, that the part may have lost its vitality, without having become dark, fetid, or emphysematous. These signs, though sometimes contemporaneous with loss of vitality, are more frequently consecutive to it, and indicate more than the simple death of the part; they are proofs of putrescence having set in as well as of death having occurred.

The processes adopted by nature for the arrest of gangrene by the formation of a line of demarcation, and for the detachment of the parts that have lost their vitality by the extension of ulceration along the line of separation, have already been fully described (p. 98).

CONSTITUTIONAL SYMPTOMS.—These vary greatly. When the disease is strictly local, affecting a part of but limited extent, and perhaps of no great importance to the economy, they are not very strongly marked. If, however, the gangrene, although limited, implicate organs of importance to the system, as a knuckle of intestine for example, marked symptoms declare themselves. Whatever the precursory condition may be, the full invasion of the gangrene, if it be of rapid occurrence, is always accompanied by constitutional disturbance of an asthenic type, attended by great depression of the powers of the system, with a dull and anxious countenance, and a feeble, quick, and easily compressible pulse; the tongue is brown, and soon becomes coated with sordes. When the gangrene is internal, a sudden cessation of pain, with hiccup, vomiting, and tympanitic distension of the abdomen, may be ascribed to the symptoms, and indicate the mischief that has occurred. Death usually supervenes with low delirium, twitchings, and coma. When the invasion of the gangrene is more gradual, as in some of the constitutional forms affecting the lower extremities, the symptoms are usually those of irritative fever, eventually subsiding into the asthenic form.

DIAGNOSIS.—The diagnosis is easily effected when gangrene has fully developed itself, but in the early stages, before it is positively declared, it

is not always an easy matter to determine its existence. The ecchymosis and discoloration of a bruise, the collapse and lividity that result from cold, or the dark purple hue occasioned by long continued congestion, may readily be confounded with impending gangrene. In these cases of doubt, the surgeon should not be in too great a hurry to pronounce an unfavourable opinion, and still less to act upon it; for it not uncommonly happens that parts of the body which have to all appearance lost their vitality, may by proper treatment regain it.

PROGNOSIS.—So far as the part itself is concerned, the prognosis is always bad; though occasionally, when gangrene has not been fully established, partial recovery may unexpectedly take place. So far as the life of the patient is at stake, much will depend on the cause of the affection, and on the age and strength of the individual; at advanced periods of life, and in a feeble state of system, the result is always unfavourable. Also whilst the gangrene is spreading, the prognosis is bad, as it is impossible to say where the morbid action may stop; but when the hue of demarcation has formed, indicating the possession of a certain vigour of constitution, the principal danger is over, and then the result will depend on the power of the patient, and the support that can be given during the processes of separation and of repair.

CAUSES.—The causes of gangrene are very various. They may be arranged under four principal heads.

1. The *Intensity or Specific Nature of the Inflammation* of a part may give rise to its death by the stagnation of the blood within its vessels, or by inducing such changes in it as are incompatible with life.

2. The *Arrest of the Circulation* through a part is a common cause of gangrene. It may be occasioned in one of three ways: by strangulation of the part generally; by obstruction of the flow of blood through the main arteries leading to it; or by the return of blood through the principal veins coming from it being interfered with.

3. *Traumatic Causes* of various kinds give rise to different forms of gangrene, most of which we have already considered. Thus gangrene of a part may be occasioned by severe contusion, compression, or laceration (page 115); by the infiltration of an irritating fluid; and, lastly, the exposure of a part to intense heat or cold will destroy the vitality of the tissues.

4. *Specific Poisons* of various kinds occasion special diseases of which gangrene is the principal characteristic. Thus, hospital gangrene, malignant pustule, noma, carbuncle, and ergotism, are instances of specific affections accompanied by gangrenous action.

Amongst the causes, some are *constitutional*, others *local*, in their action. Those forms of gangrene are said to be *constitutional* which arise from intense or specific inflammation of the part; from obstruction of the circulation in consequence of a diseased state of the heart and vessels; or from the action of various specific poisons. On the other hand, those varieties of gangrene are *local* which arise from injuries of all kinds, whether applied to the part itself, or to the main artery leading to it, by its ligature or wound.

Some of the varieties of gangrene that have just been indicated, such as those arising from the intensity of the inflammation, and from various traumatic causes, have already been discussed (pp. 97, 115); whilst those that arise from obstructed circulation, or that take the form of specific diseases, are left for our consideration here.

GANGRENE FROM ARREST OF CIRCULATION.—Arrest of circulation may act in three ways in inducing gangrene:—1, by the arrest of all the blood, arterial, venous, and capillary, in the part, as in Strangulation by a tight

ligature; 2, by *Obstruction of the Arteries*, and consequent deprivation of blood; and 3, by *Venous Obstruction*, and consequent over-accumulation of blood.

1. *Strangulation*.—A part is often purposely strangled by a surgeon in operative procedures; or its circulation may in this way be arrested as the result of certain diseased conditions. In either case, the strangulation acts by stopping more or less completely the whole circulation of the part. If it be sufficiently severe, it may kill the tissues outright: for instance, when a nœvus or a pile is tied, all flow of blood to or from the part is suddenly arrested, and its vitality is destroyed, the tissues that have been strangled shrivelling and separating by ulceration along the line of ligature. When the strangulation is not so severe as this, great congestion in the part ensues, consequent on the interference with the return of the venous blood; the part strangled becoming dark and congested, phlyctenæ or vesicles arising on its surface, and effusion taking place into its tissue; inflammation becoming at last superadded to the effects of the strangulation, and still more embarrassing the circulation of the part, sloughing arises from the conjoined action of the strangulation and the inflammation: all this we see occurring in the constricted gut in a strangulated hernia.

2. *Arterial Obstruction*.—When a part of the body is deprived of its proper supply of blood, mortification may ensue. This we see occasionally happen when the circulation through the main artery of a limb is arrested by its ligature or wound. Most commonly, when the principal trunk of an artery is obstructed, the collateral circulation is sufficient to maintain the vitality of the part; but should this be interfered with in any way, gangrene ensues from the simple deprivation of that blood which is necessary to the maintenance of its life. Indeed, the sudden loss of a large quantity of blood from the system generally may occasion the death of some of the extreme parts of the body, in which the circulation is naturally most languid. Thus Sir B. Brodie relates the case of a drunken man, who, being bled to an inordinate extent, was seized with gangrene of both feet.

The want of a due supply of arterial blood to the limb may be occasioned by two primary sets of causes:—*a*, from *injury or operation*, as wound or ligature of the main trunk; *b*, from *disease*, as by *obstructive arteritis*; by *embolism*; by *calcification*, and consequent *occlusion of the vessel*. Gangrene from arterial obstruction varies materially in its symptoms, prognosis, and treatment, according as it arises from one or other of these causes.

a. When a limb becomes gangrenous in consequence of the *Ligature or Wound of its Main Artery*, without any other injury to the vascular system, it will be found to become cold, to feel heavy, and to lose its sensibility; at the same time it assumes a dull tallowy-white colour, mottled with greyish or brownish streaks. This state of things is chiefly met with in the lower extremity; the integuments of the foot die, becoming semi-transparent and horny looking where they are stretched over the tendons of the instep, and the part presents a shrivelled appearance. In the course of a short time the pallid colour will be lost, the part becoming brown or blackish. This form of gangrene may invade the whole of the lower limb, but most commonly is limited to the foot, stopping either just above the ankle, or if not, then immediately below the knee, as Guthrie has observed: the arrest taking place in one or other of these two spots, on account of the greater freedom of the collateral circulation here than in other parts of the limb. If any of the large venous trunks become obstructed or otherwise implicated, so that the return of blood through them is interfered with at the same time that the supply by the arteries is arrested, the limb generally assumes a greenish-

blue colour, and rapidly runs into putrefaction. In some of these cases it happens that sloughs of the integument and subcutaneous cellular tissue form, although the limb generally preserves its vitality. The treatment of these forms of gangrene, which are strictly local, is described in the chapter on the Arrest of Arterial Hemorrhage (p. 183).

b. Gangrene may occur from the circulation being arrested by *thrombosis* taking place in the coats of the arteries, or in the contained blood. This is the variety of the affection that is commonly called *Spontaneous*. It may be the result either of obstructive arteritis, of embolism, or of the plugging up of an artery that has undergone calcification or senile degeneration.

Spontaneous gangrene from *Acute Obstructive Arteritis*, without previous disease of the vessel, may occur at all ages; in young people as well as in old. In it there are the usual signs of arteritis, such as tenderness along the course of the vessel, cessation of pulsation in its terminal branches, intense superficial pain in the limb, followed by the rapid supervention of dark dry gangrene in the whole of the extremity up to the point at which the vessel is inflamed. In some cases the gangrene partakes of the characters of the humid form, owing to the implication of the contiguous veins. It is, I believe, most frequently met with in the upper extremities; at least, most of the instances that I have seen of it have been situated there. I have observed it most commonly in women, occurring sometimes at an early period of life, even at the 18th year. Its causes are very obscure; in some cases the disease appears to be of rheumatic origin, in others it is connected with a cachectic and broken state of constitution. It frequently proves fatal by the supervention of typhoid symptoms, before any attempt can be made by nature to separate the mortified part. After death, the inflamed vessel will be found firmly plugged up by a dense coagulum, which completely arrests the circulation through it. It is by the formation of these coagula plugs or emboli that arteritis occasions gangrene. In these cases the terminal branches of the arteries, and the capillary vessels, become plugged by a mass of finely granular fibrinous matter, which is washed down and into the lower part of the vessel from the inflamed patch on the inner surface of the artery at a higher point. In peculiar conditions of the blood, at present of an uncertain character, this plugging is more specially apt to occur.

Embolism is a cause of spontaneous gangrene. In some cases the gangrene appears to be occasioned by a plug of plastic matter which has been detached from a distant part of the circulatory apparatus, from the interior of the left ventricle for instance, and, being carried by the circulation into the arterial system, stops at some point of bifurcation or of narrowing of a vessel. In such cases the gangrene may develop itself suddenly. The accompanying drawing (Fig. 152) represents the bifurcation of the common femoral artery occupied by a fibrinous plug, taken from a man aged 32, who died of gangrene of the left leg. In this case the patient, after recovering from rheumatic endocarditis, whilst straining at stool, suddenly felt his left leg become tingling, then numb and cold. The circulation in it ceased, and gangrene speedily supervened, which extended as high as the knee. Death followed amputation of the limb. Here there can be little doubt that the sudden supervention of gangrene was the result of obstruction to the arterial circulation of the lower extremity, consequent on the detachment of a fibrinous endocardial plug, and its arrest at the bifurcation of the femoral artery.



FIG. 152.—Obstruction of Femoral Artery at its Bifurcation by a Fibrinous Plug.

Spontaneous gangrene is termed *Senile* when it occurs in consequence of the *Contents of the Arteries becoming Rigid and Calcified* (Fig. 153), and unable to maintain the circulation of the limb. It is met with in the lower extremities of people past the middle period of life, and increases as age advances. A sensation of weight in the limb occurs, with coldness, itching, and tingling in the feet, and with cramps in the calves; and the circulation of the part is habitually defective. This condition commonly exists for a considerable length of time before gangrene comes on. In many instances this acts in without any exciting cause; but in other cases the mortification is immediately set up as the result of some slight inflammation accidentally induced, as from the excoriation produced by a tight boot, or from a trivial wound in cutting a corn; the inflammation occasioned by this slight injury being sufficient to disturb the balance of the circulation in the already weakened part to so great an extent, that gangrene ensues. This generally makes its appearance in the form of a cold purple or blackish-red spot on the side of one of the toes; this spot may be surrounded by an inflamed areola, and accompanied by much smarting and burning pain; it spreads by gradually involving the inflamed areola, which continues to extend in proportion as the gangrene progresses. In other cases the toes and feet simply shrivel, without any sign of local inflammation or constitutional disturbance. In one or other of these ways the affection gradually creeps up the limb, invading perhaps one toe after the other, involving the instep and the sole of the foot; and, unless it terminate by the formation of the line of demarcation, or death put an end to the patient's sufferings, it may extend up the ankle or leg. The part that is destroyed is always black, dry, and shrivelled, resembling closely in appearance a dried mummy; hence the change is often termed *mummification* (Fig. 154). There is usually considerable constitutional disturbance, sometimes pyrexial at first, but secondarily sinking into an irritative or asthenic form, and the disease is generally fatal in from a month to six weeks. I have known the disease to continue, however, with very little constitutional disturbance for more than twelve months. In other instances, again, the gangrene being limited to a small extent, as one or two toes, the patient may recover.

The pathology of the arterial system, in reference to these forms of gangrene, will be more fully discussed in a subsequent chapter.

3. *Venous Obstruction*. — Gangrene may arise from obstruction to the return of blood through the veins of a part, the circulation being affected by the overflowing of the capillaries with venous blood. Gangrene is especially apt to take place if the arterial supply be diminished at the same



Fig. 153.—Femoral and Iliac Arteries obstructed in Senile Gangrene.



Fig. 154.—Senile Gangrene of Foot.

time that the return of venous blood is interfered with ; as when an artery and vein are compressed, or when the femoral vein is wounded accidentally at the time when the artery is ligatured. Gangrene from this cause is always of the moist kind, attended by great swelling from oedema, with discoloration and rapid putrefaction of the part.

This gangrene from venous obstruction is also especially apt to occur in those cases in which the heart's action is weakened, so that the force of the impulse in the arterial system is so lowered as to be unable to push the blood through the loaded veins. Those cases of gangrene of the extremities that are met with from pure debility, as after fevers, often appear to originate in this way.

The various forms of *Traumatic Gangrene*, whether arising from the severity of the injury, from the inflammation following it, from the depraved condition of the blood, from the irritation of extravasated fluids, or from the effects of burns, or of frostbite, have already been considered when treating of these respective injuries ; and the more *Specific* forms of the affection we shall shortly describe.

TREATMENT.—As gangrene proceeds from a great variety of causes, it must be very evident that no one plan of treatment can be universally applicable ; and it becomes necessary to modify our therapeutic means, not only according to the cause of the disease, but also with special reference to the constitution of the patient, and with regard to the stage in which we meet with the gangrene ; and, indeed, it often requires great tact and experience to accommodate the treatment in this way to the varying phases of the case. I have already considered the treatment of the inflammatory (p. 98) and the traumatic and local (pp. 120, 185) forms of gangrene, and shall, therefore, consider merely in this place the general principles that guide us in the management of those varieties that have been considered as the result of constitutional causes—the *spontaneous* forms ; and in these cases the constitutional management of the patient is of greater moment than the local treatment of the disease.

In the *Constitutional Treatment* of spontaneous gangrene, there are three principal indications. 1. To remove the cause, if possible, and thus to arrest the gangrene. 2. To support the powers of the system during the process of the separation of the sloughs ; and 3. To lessen the irritability of the nervous system.

1. In the removal of the constitutional cause, we must look wholly to the condition of the patient's system ; if this be in an inflammatory or febrile state, we must have recourse to the modified antiphlogistic plan described at p. 98. But the opposite condition—an enfeebled state of the circulation of the part, or the system generally—may equally occasion or complicate the gangrene ; and there may be every possible combination between this and the active inflammatory condition. Under these circumstances, it will be necessary to coujoin an antiphlogistic plan of treatment with remedies of a tonic, or even stimulating character. It is this plan of treatment that is commonly found to succeed best in spontaneous gangrene ; here moderate antiphlogistics are perhaps required in the earlier stages, with a light nutritious diet and mild tonics as the disease advances ; and in the later periods, when the constitutional symptoms assume an asthenic character, stimulants should be given. The best stimulants in these cases are wine or porter, according to the patient's habits of life ; and these should be given in combination with nourishment, so as not merely to raise the pulse, but to produce a more permanent tonic influence on the system generally. If much depression occur, the medicinal stimulants, especially ether, ammonia, and camphor,

are of material service. The only tonics that are of much value here, are the preparations of bark and some of the vegetable bitters, as gentian and cascarella; and though the specific virtues that were formerly attributed to them can no longer be accorded, yet, when they do not irritate the stomach, they are of unquestionable service in combating the asthenic symptoms and improving the digestive powers. In these cases I look upon bark or gentian, in combination with chlorate of potass and ammonia, as of undoubted value.

2. After the proper employment of means calculated to remove the constitutional cause of the gangrene, the system must be supported against the debilitating effects that accompany the process of ulceration and of suppuration necessary for the separation of the mortified parts. During this period, there is less irritation and more debility, and stronger tonics and stimulants can be borne; but we should be careful not to overstimulate the patient. On this point it is extremely difficult to lay down any rule; every possible variety as to the quantity and quality of food and stimulus being required by different individuals. The safest guides are the state of the pulse and tongue; if they improve, the means employed agree. At the same time, hygienic measures should be carefully attended to; cleanliness and free ventilation, with the abundant use of the chlorides, are of the first moment, so that the patient may not be poisoned by his own exhalations.

3. The third indication, that of lessening the irritability of the system that always supervenes, and which is partly owing to the severity of the pain, and partly to the shaken and depressed state of the nervous system, is best carried out by the administration of opium; and although this drug may not act as a specific, as Pott supposed, yet in many cases, but especially in the gangrene of the toes and feet of old people, it is undoubtedly a remedy of the greatest value. A grain of solid opium may be administered advantageously every sixth, eighth, or twelfth hour, according to the effect which it is found to produce; care being taken that the bowels do not become confined. The lincup, which is often distressing in these cases, is best remedied by the administration of chloric ether and camphor.

The Local Treatment of the gangrenous part should be conducted on the principles described at p. 98, leaving the separation of the sloughs as much as possible to nature; diminishing the fœtor which occurs, by the use of the chlorides; preventing the absorption of morbid matters by the line of separation; dressing this with wet lint or calamine cerate; and, lastly, endeavouring to heal the ulcer that results on the detachment of the sloughs.

THE TREATMENT OF SENILE GANGRENE, presenting, as it does, some peculiarities, requires a few words to be specially devoted to it.

Constitutional Treatment.—By some surgeons this disease has been treated on a strictly antiphlogistic plan, on the supposition that the obstruction of the arteries is caused by the inflammation of their coats. Thus, however true it may be in some of the forms of "Spontaneous Gangrene" arising from acute obstructive arteritis in young subjects, is certainly an erroneous doctrine in the great majority of cases of dry gangrene occurring as the result of senile changes in the lower extremities of aged persons; and though inflammation may occasionally affect the calcified coats of an artery, it is always a low form of the disease, and does not bear depletion. Sir B. Brodie very justly observes, that in these cases the local precursory inflammation terminates in mortification, because the inflamed part cannot obtain the additional supply of blood that it requires, hence, if blood be abstracted from the system, and the action of the heart weakened, the cause of the

disease will only be aggravated. But, though depletory measures are not admissible, we must guard against running into the opposite extreme, and overstimulating patients labouring under this disease. Senile gangrene commonly occurs in individuals belonging to the wealthier classes of society, who have lived high, taken insufficient exercise, and consequently incurred an irritated, plethoric, but enfeebled state of system. In this condition stimulants and the more powerful tonics are not well borne; they heat the system, accelerate the pulse, and interfere with digestion. As Sir E. Broussais observes, it is of great importance in this disease to attend to the state of the digestive organs, in order that nutrition may go on, and that blood of a proper quality may be made. In order to accomplish this, a light nourishing diet, partly animal and partly vegetable, should be given, and a moderate quantity of wine, beer, or brandy allowed. The bowels must be relieved from time to time by a rhubarb draught or simple aperient pill. It is better to avoid mercury as an aperient in any form in this disease, as it depresses the system; and hence it should not be used, unless the state of the system imperatively require it. If the digestion becomes impaired, a stomachic in the infusion of cascarrilla, or the compound infusion of gentian with a little ammonia, may be administered. The administration of opium in these cases, as recommended by Mr. Pott, has received the sanction of almost every practical surgeon. Sir B. Brodie's opinion on this point is peculiarly valuable; he says, "If I am not greatly mistaken, the result of a particular case will very much depend on this—whether opium does or does not agree with the patient." From two to four grains of opium may be administered in divided doses in the course of twenty-four hours; the quantity being increased as the system becomes accustomed to its effects. If, however, it disturb the stomach and occasion headache, notwithstanding the use of aperients, as will often happen when there is febrile disturbance in persons of a full habit of body, it must be discontinued, as it will increase the irritation of the system. With respect to the comparative advantages of the depletory and stimulating plans of treatment in senile gangrene, I think it may fairly be stated that neither method should be employed exclusively, that in those cases in which there is much febrile action going on, in which the tongue is loaded, the pulse quick, and the skin hot, in which the spread of the gangrene is preceded by a red angry blush, with much pain and heat, moderate diet and mild tonics will be most useful; whilst, on the other hand, when it is simply a shrivelling of the toes and feet, without any sign of being preceded by increased local action, or by constitutional disturbance of a febrile type, a decided tonic or stimulating plan will succeed best.

The *Local Means* to be employed in senile gangrene are simple. It is of great importance to keep up the temperature of the limb, and to equalise its circulation as much as possible; this is best done by the application of cotton-wadding or of carded wool in thick layers around the foot and leg, so as to envelop the limb completely in this material, over which a large worsted stocking may be drawn, or a silk handkerchief stitched. This dressing need not be removed more than once or twice a week, unless there be much discharge from the line of separation, when it must be changed more frequently; the gangrened part itself should be covered with a piece of lint soaked in chlorinated lotions. When the soft parts have been separated, and the bones of the foot exposed, these should be cut across by means of cutting-pliers or a small saw, and the sore that results dressed in the ordinary way with some astringent lotion or slightly stimulating ointment. The balsam of Peru, either pure or diluted, with an equal part of yolk of

is a very excellent application in these cases. In the event of the recovery of the patient, he must be careful to avoid exposure to cold, and to keep the legs warmly clad at all seasons of the year.

AMPUTATION IN GANGRENE.—The question of amputation in cases of gangrene of the limbs is of great importance to the practical surgeon, and is one on certain points of which the opinions of the best practitioners are still at variance. At first sight it appears rational to cut off a limb that is dead, disorganised, and offensive; and with propriety this may be done when the gangrene is, strictly speaking, a local condition, as, for instance, the result of a severe injury: any affection of the constitution in such a case as this being secondary to the local mischief, and dependent on the irritation set up by it, and on the depression of the powers of life consequent on the effort made by nature to rid the system of a spoiled member. But when the constitutional disease is the primary affection, and when the gangrene is consecutive to and dependent upon this, it would clearly be useless to cut off the mortified part, as the same morbid action might and would be set up in the stump or elsewhere. Hence the broad question of amputation in cases of gangrene turns upon the fact of the mortification being local or constitutional in its origin.

When the gangrene is *local*, therefore, we usually amputate at once. This is especially the case when the mortification results from severe injuries, or is the result of the wound or ligation of an artery. Here, I think, for the reasons which have been given (p. 185), that amputation should be performed as soon as the gangrene has unequivocally manifested itself, without waiting for the line of demarcation. The result of amputation for traumatic gangrene is, on the whole, very unfavourable; the patient very commonly sinking from a recurrence of the disease in the stump, or from the constitutional disturbance that had previously set in. Those cases are especially unfavourable in which the cellular tissue of the limb is much infiltrated and disorganised; the affection indeed partaking more of the characters of constitutional disease, with some forms of which it is closely associated.

There are two exceptions to the rule of amputating in traumatic and local gangrene before the occurrence of the line of demarcation; viz., gangrene from frost-bite, and that from severe burns. In these injuries it is better to wait for the formation of the line of separation, and then to fashion the stump through or just above it as the circumstances of the case require.

In gangrene from *constitutional* causes, it is a golden rule in surgery never to amputate until the line of separation has formed; for, as it is impossible in these cases to say where the mortification will stop, the amputation might be done either too high, or not high enough; and, under any circumstances, the morbid action would to a certainty be set up in the stump. It is not even sufficient in cases of this kind to wait until the line of demarcation has formed before removing the limb, these spontaneous or constitutional gangrenes having often a tendency to remain stationary for some days, and then, creeping on, to overstep the line by which they had at first appeared to be arrested. Besides this, the local disturbance and inflammation set up by the amputation might be too great for the lessened vitality of the system or part, and might of itself occasion a recurrence of the gangrene. Hence in these cases it is always well to wait until the line of separation has elevated so deeply that there is no chance of the gangrene overleaping this barrier, at the same time that means are taken, by the administration of tonics, nourishing food, &c., to improve the patient's strength and fitness for the operation. As soon as this has been done in a satisfactory manner,

and all the soft parts, except the ligaments, have been ulcerated through, the mortified part should be separated by cutting through the remaining osseous, ligamentous, or tendinous structures, and then means should be taken to fashion the stump that has been formed by nature. In some cases this will be sufficiently regular to serve every useful purpose after it has cicatrised. In most instances, however, the stump is more irregular in shape and ungainly in appearance, of which the accompanying drawing (Fig. 155) is a good illustration; and it will be found that the bones protrude to such an extent,



Fig. 155.—Spontaneous Amputation in Gangrene of Right Foot and Left Leg from Plastic Arteritis.

or that the ulceration has affected the soft parts so irregularly, that it will be necessary, in order to give the patient a useful limb, to amputate through the face of the stump, or higher up; all this, however, must be left to the discretion of the surgeon, but no pro-

cedures of this kind should be undertaken until the patient's strength has been restored sufficiently to bear the operation.

In *senile gangrene* it has recently been proposed to amputate the thigh high up. This practice has been successfully adopted by Mr. Garlike, Mr. James of Exeter, and others, and certainly appears to deserve a trial in all cases in which the health is otherwise good and the constitution tolerably sound. It has not as yet been adopted in a sufficient number of cases to warrant a positive opinion on its merits; but it would appear that, for it to succeed, the amputation should be done high up in the thigh, so that there may be a better chance of meeting with a healthy condition of the vessels and great vitality in the limb; the operation being performed on the principle, that this form of gangrene is dependent on local disease obstructing the vessels of the part, and not always on constitutional causes.

CHAPTER XXXI.

GANGRENOUS DISEASES.

BED SORES.

WHEN a part of the body is compressed too severely, or for too long a time, even in a healthy constitution, it loses its vitality, and a local limited slough results; this separates, and an ulcer is left, which cicatrises in the usual way. But in certain deranged states of the health, more especially when the blood is vitiated, and the constitutional powers lowered, as during fever, or when the patient is old, debilitated, or paralysed, the skin covering those points of the body that are pressed upon in the recumbent position, such as the sacrum, the trochanters, the elbows, shoulders, and heels, becomes congested and inflamed, assuming a dull reddish-brown colour, and speedily becomes excoriated without any pain being felt by the patient. If means be taken

taken to relieve the part from the injurious compression to which it is subjected, and more especially if it be irritated by the contact of feces or urine, the subcutaneous cellular tissue corresponding to the inflamed patch will be found to have become widely softened and doughy, being converted, with the skin covering it, into a tough greyish slough, from under which a thin ichorous pus exudes. This slough may extend by a process of undermining of the integuments covering it; and on its separation extensive mischief will be disclosed, the fascia and tendons being exposed, or the bones laid bare, and soon becoming roughened and carious. In some cases, even the inferior aperture of the spinal canal may be laid open, and death may result from a low form of arachnitis, in consequence of the irritation spreading to the membranes of the cord. In other cases, the patient dies worn out by discharge and irritation.

TREATMENT.—This is in a great measure of a preventive character. When a patient is likely to be confined to bed for many weeks, especially by an exhausting disease, steps should be taken by proper arrangement of the pillows, and by the use of the water-bed and cushions, to prevent pressure from being injuriously exercised upon any one part. At the same time, cleanliness and dryness should be carefully attended to by proper nursing, by the use of a draw-sheet, and furnishing the bedstead with the necessary arrangements of bed-pan, &c. The skin on the exposed parts may be protected by the application of collodion or soap-pluister spread upon wash-leather or amadou, or bauglass or felt; or, what is better, it may be strengthened by being washed with spirits of wine, either pure or having two grains of bichloride of mercury dissolved in each ounce.

If the skin have become chafed, the removal of pressure is imperative, and the abrasion may be washed over with collodion; if a sore have formed, it may be dressed with the balsam of Peru, either pure or diluted with the yolk of egg, spread upon lint. In these cases also the use of the prone couch may occasionally be advantageously substituted for that of the ordinary bed previously employed. When sloughs have formed their separation must be facilitated by the use of charcoal or chlorinated poultices, and the ulcers that are left should be dressed with astringent and aromatic applications, such as catechu, tincture of myrrh, &c.; but no dressing that the surgeon can apply will cause these ulcers to heal unless the patient's general health improve, and then they will speedily get well under simple treatment.

SLOUGHING PHAGEDÆNA.

This affection, which is also commonly known by the names of *Hospital*, *Contagious*, or *Pulpy Gangrene*, is characterized by a rapidly destructive and spreading ulcer, covering itself as it extends by an adherent slough, and attacking open sores and wounds. It is rarely met with in its fullest extent, except in military practice, the accumulation of a large number of wounded with suppurating sores under one roof, and the want of the necessary cleanliness and attention during an active campaign, disposing to it. Overcrowding of a hospital is the most fertile cause of this disease. It used formerly to desolate the civil hospitals, but, thanks to the sanitary measures now so generally adopted in these institutions, it has almost disappeared from them, though still an outbreak of it occasionally takes place. During the last few years, it has been met with in most of the London hospitals, and has twice made its appearance in that of the University College.

Local Signs.—When sloughing phagedæna invades a wound that is previously perfectly healthy, the surface of the sore becomes covered with grey soft points of slough, which rapidly extend, until the whole of the ulcer

is affected. At the same time it increases rapidly in superficial extent, and commonly in depth; the surrounding integument becomes oedematous, swollen, and of a livid red colour; the edges of the ulcer are everted, sharp cut, and assume a circular outline; and its surface is covered with a thick pulpy greyish-green tenacious mass, which is so firmly adherent to the skin that it cannot be wiped from it, being merely moved or swayed to and fro when an attempt is made to remove it. There is usually some very yellowish-green or brownish discharge, and occasionally some bleeding; the pain is of a severe burning, stinging, and lancinating character, and the odor from the surface is considerable. The ravages of this disease, when fully developed, are very extensive. The soft parts, such as the muscles, cellular tissue, and vessels, are transformed into a grey pulpy mass, and the bones are denuded and necrosed. The larger bloodvessels resist the progress of the disease longer than any other parts, but may at last be exposed, pulsating at the bottom of the deep and foul chasm. There is, however, little risk of hemorrhage taking place in the early stages; but, when the sloughs are separating, an artery may give way, and bleeding to a dangerous or fatal extent ensue. Hennen states that there is most danger of this happening about the eleventh day. When the sloughs are thrown off, in the form of reddish-brown or greyish-green, viscid, and pulpy masses, a very sensitive granulating surface is left, having a great tendency to bleed, and to be again invaded by the sloughing action.

Blackadder has described an ulcerated form of this affection, in which a vesicle containing a bloody ichor forms, with a hot stinging pain, this breaks, leaving a circular ulceration of about the size of a split pea. The ulceration, once formed, rapidly extends by sharp-cut edges into the surrounding integument.

On the two occasions in which I have had the opportunity of witnessing outbreaks of this disease in University College Hospital, the surface of the wound affected became rapidly covered with a yellowish-grey pultaceous slough. In some cases there was hemorrhage; but most commonly a small quantity of fetid discharge only was poured out, the edges of the sore became sharp-cut and defined, and the ulceration extended further in the skin by an eighth or a quarter of an inch than in the subjacent cellular tissue. In the majority of instances the disease was confined to the skin and cellular tissue, exposing but not usually invading the muscles and bones, though in some cases these were affected. The ulcers, which had a somewhat circular shape, were surrounded by a dusky inflamed areola of some width. When once the morbid action was stopped, they cleaned rapidly, throwing out large vascular granulations.

CONSTITUTIONAL SYMPTOMS.—These are inflammatory in the first instance, with a tendency to asthenic and irritative fever as the disease advances. In the majority of cases they follow the local invasion of the sore; Blackadder, Rollo, Delpech, and Willbank have all found this to be the case, and in the instances at University College Hospital it certainly was so. Hennen and Thompson, on the other hand, state that the constitutional symptoms precede the local. This discrepancy of observation may be explained by the difference in the cause of the disease; if it occur from contagion, the constitutional symptoms will be secondary; if from causes acting on the general system, they may probably be primary, to the local affection.

All wounds and sores are liable to be attacked in this way, but the disease most frequently affects those that are of recent origin, the more chronic affections, and those that are specific, very usually escape.

CAUSES.—Primarily, this form of gangrene commonly originates from

overcrowding of patients in hospitals. This I believe to be the great common cause of hospital gangrene and sloughing phagedena, more particularly if patients with suppurating wounds be overcrowded in the same ward or room. I believe that in this way the disease may at any time be produced. The last outbreak that occurred at University College Hospital was clearly referable to that cause, and to that cause only. In one of my wards, which is intended to contain 15 or 16 patients only, owing to accidental and unavoidable circumstances, 21 patients were admitted, and slept for one night, many of them having suppurating wounds. The result was an outbreak of hospital gangrene, which spread through the Institution, and was of the most serious and persistent character. Next to overcrowding, I believe that the most fertile causes of this disease are want of cleanliness and ventilation, and change of dressings; that accumulation, indeed, of animal exhalations arising from the sick and wounded, which is a source of various forms of low fever and of allied diseases; and when it so occurs, this disease may be taken as evidence of the infringement of the sanitary laws in accordance with which the arrangements of the Institution should be regulated. But though it commonly has its origin in this way, especially in the crowding of military hospitals after a hard-fought action, it is met with out of hospitals. Well-marked cases of this affection, some of a very severe character, have at times occurred amongst the out-patients of University College Hospital. In these cases, as in many others, it was probable that the disease was occasioned by the neglect of hygienic conditions in the close and ill-ventilated houses of the poor, aided possibly by some atmospheric or epidemic influence; influenza, erysipelas, and phlebotomy being also very prevalent. This had been observed at the time of the first occurrence of the disease at our hospital, in 1841; and I think it is difficult not to recognise a similarity of cause in these different affections. When once it has occurred, it may readily spread by contagion, though there is no evidence to show that it is of an infectious character. Hence the necessity of preventing its spread by nurses or attendants, by the cautious use of sponges, and of destroying the dressings used by the patients.

Treatment.—The first point to attend to is to *prevent the extension of the disease* to patients who are not as yet affected by it. This may be done by separating those who have been seized with it from the healthy, by preventing overcrowding of the hospital, ventilating the wards, washing the floor with a solution of the chlorides, whitening the walls, and fumigating the apartment with chlorine gas.

Local Treatment.—The *extension of the slough* must be stopped by the free application of fuming nitric acid, or of the actual cautery, to the edges and surface of the ulcer. I have used both these agents, but give the preference to the nitric acid, if strong and freely applied, the sides and edges being well sponged with it. The actual cautery is, however, very useful in those cases in which the surface to be destroyed is very extensive, or if there be a tendency to hemorrhage. Should it not reach the deeper portions of the sore, nitric acid may be freely sponged into them. It is important to bear in mind that these escharotic applications should be carried deeply, so as to affect the living structures lying beneath the tenacious grey pulpy slough, and that their action be not fruitlessly expended upon charring this, which is already disorganised. After the canterisation a strip of lint, soaked in a strong solution of the watery extract of opium, should be laid around the margin of the ulcer, so as to cover the surrounding areola; and the separation of the sloughs must be encouraged by the continued application of

charcoal, yeast, or chlorinated poultices. When they have separated, and the surface of the sore has cleaned, it may be dressed with a lotion composed of one grain of the sulphate of copper, and five of the watery extract of opium to the ounce of water. The granulations, which are very luxuriant and vascular, will be found to skum over with great rapidity; and the cicatrix, like that of an ordinary burn, will contract very firmly.

Should *arterial hemorrhage* occur, it may be arrested by the application of a ligature to the bleeding point; but if this do not hold, as will probably be the case from the softened state of the tissues, the perchloride of iron or the actual cautery must be applied; or the limb must be at last removed, in the event of all other means failing.

In some cases it happens that, though the sloughing action is checked in one part of the surface, it has a tendency to spread at another. When this is the case, it may be necessary to apply the caustic or cautery repeatedly. In other instances, the sloughing action cannot be stopped, but opens large arteries, and destroys the greater part of the soft tissues of a limb; and then it may be a question whether amputation should be performed during the spread of the disease, or the patient left to die of hemorrhage or exhaustion. Such a contingency is not of common occurrence; but yet it may happen and the operation be successful, as appears from the following case, though there would necessarily be great danger from a recurrence of the disease in the stump. The wife of a butcher applied at the hospital, with a slight wound of the forearm, inflicted by a foul hook. It was dressed in the ordinary way, but in the course of a few days she returned with extensive sloughing phagedæna of the part; she was immediately admitted, and the disease was arrested by the energetic employment of the local treatment above described, not, however, until after considerable destruction of the tissues on the inside of the forearm had taken place. She left the hospital before the wound was completely cicatrised, and returned in a few days with a fresh attack of the disease, more extensive and severe than the first, and which could not be permanently stopped, either by the actual cautery or by nitric acid. The radial artery was opened and required ligature, and the whole of the soft parts, from the wrist to the elbow, were totally disorganised, and the bones exposed. There was now very severe constitutional irritation, and the case was evidently fast hastening to a fatal termination. Under these circumstances I amputated the arm midway between the shoulder and elbow; and, notwithstanding that the local disease was progressing at the time of the operation, and that great constitutional disturbance existed, the patient having a pulse of 160 to 170, at which it continued for more than a fortnight, she made a good recovery; to which the free administration of quinine and stimulants greatly contributed.

The *Constitutional Treatment* of this disease must have for its object the removal of the combined state of debility and irritation in which we find the patient. The bowels should be opened, if necessary, by warm aperients; as nourishing a diet as the patient will take, with a liberal supply of stimulants, should be ordered; and these may be increased by the addition of the brandy-and egg mixture, or of ammonia, in proportion as depression comes on. At the same time, I have found great advantage from the administration of a mixture of carbonate of ammonia, gr. v.; chlorate of potass, (℥j), compound tincture of bark, ℥j; decoction of bark, ℥iiss, every four or six hours; or, if the patient will bear it, from five to seven grains of the sulphate of quinine every four or six hours, with a full dose of opiate at bed time, or more frequently if there be much pain and irritation.

GANGRENOUS STOMATITIS, OR CANCERUM ORIS.

A peculiar phagedænic ulceration closely resembling the last-described affection is occasionally met with in the mouths of ill-fed children living in low and damp situations, most commonly occurring between the second and sixth or eighth years, but more especially about the period of the second dentition.

The mildest form of this affection presents itself as small, deep, and foul greyish ulcers, situated on the inside of the lips or cheeks, and attended with a red spongy condition of the gums and much foetor of the breath. In these cases, good food and air with nourishing diet, the administration of bark, with the chlorate of potass, and the use of chlorinated lotions, with the honey of borax, will soon bring about a cure. The Spanish snuff (*Sabilla*) applied to the sore mouth, or placed in a small cambric bag on the tongue, has a very good effect in cleansing these sores, and especially in soothing irritation.

SIGNS OF CANCERUM ORIS.—In the more severe form of the affection, the true *Cancerum Oris*, we find, commonly during convalescence from some of the eruptive diseases of childhood, or after the incautious administration of mercury during a weak state of the system, that one of the cheeks becomes swollen, brawny, tense, and shining, being excessively hard, and presenting a red patch in its centre. In consequence of this swelling, it is often difficult to open the mouth; but if the surgeon can gain a view of its inside, he will see a deep and excavated foul ulcer opposite to the centre of the external swelling covered with a brown pulpy slough. The gums are turgid, dark, and ulcerated; the saliva is mixed with putrescent matters; and, as the ulceration in the mouth extends, the swelling alongs, and a large, dark, circular gangrenous cavity forms in the cheek, opening through into the mouth; during all this time the child suffers little, but, as the disease advances, it commonly becomes drowsy, and at last dies comatose. When fully developed, this affection is most fatal. Rilliet and Barthez state that not more than one in twenty cases recovers.

TREATMENT.—The treatment is that of hospital gangrene. The sloughing mass should be deeply cauterised with nitric acid, but not with the actual cautery, lest the cheek be destroyed; the mouth should be syringed with the dilute solution of the chlorides; and the system supported with beef-tea, wine, and ammonia, in doses proportioned to the age of the child. After the cure of the disease, the cheek may be deeply cicatrised, contracted, and rigid, much in the same way as after a burn, requiring possibly some plastic operation in order to enable the child to open its mouth properly.

BOILS.

A *boil* is a hard circumscribed tumour of a violet or purplish-red colour, flattened, though somewhat conical, suppurating slowly and imperfectly, and always attended by a small conical central slough of cellular tissue called a *core*. It consists of an inflammation of the subcutaneous cellular tissue and of the under surface of the true skin. The tension and hardness accompanying this affection render it extremely painful and annoying to the patient. It is most commonly seated in the thick skin of the back, the neck, or the nates.

Cause.—Boils most frequently make their appearance in young people, but are common enough at all ages, and are usually seen either in very plethoric or in very enfeebled constitutions, often following some of the more severe febrile diseases, and attending convalescence from them. In other cases, the system appears to have fallen into a cachectic state, often

without any evident cause, and this terminates by a critical eruption of boils. A sudden change in the habits of life, as from sedentary to active pursuits, a course of sea bathing, &c., will also occasion them. They are commonly met with in the spring of the year, but may occur at all seasons, and are occasionally epidemic, as has been the case during the last few years in London. When once they take place they are often extremely tedious, crop after crop continuing to be evolved. In many cases they must be looked upon as salutary, as being the means adopted by nature to rid the patient of morbid matters that are sources of irritation in, and might if retained become sources of disease to, the constitution. Hence, after an outbreak of boils, the health often greatly improves.

TREATMENT.—The constitutional condition of the patient, on which the disease is dependent, requires to be carefully attended to. No one remedy is capable of curing boils. The disease is the result, in some cases, of faulty or defective nutrition, and the gradual modification and improvement of those processes that are subservient to it are necessary before the local eruptive affection will cease to appear. In other instances, it appears to be due to want of proper elimination of effete materials from the system. Hence less is often to be expected from medicines in these cases, than from a general regulation of the hygienic condition of the patient. Nature will do more for his recovery than art; and the utmost that the practitioner can do is to administer such remedies as will assist in the improvement of his constitutional condition. If he be debilitated and cachectic, iron, quinine, sarsaparilla, and cod-liver oil; if he be plethoric, and his system loaded, purgatives, salines, and liquor potassæ will be appropriate. In the one case an abundant nourishing diet, in the other case a spare and simple one, with avoidance of stimulants, will be required.

In some cases, empirical means are of service. Thus, when the disease is associated with pompholyx, or preceded by painful vesicles, arsenic may be of benefit. In other instances yeast or charcoal has been advantageously given.

The *Local Treatment* of boils is simple. When they are forming, the most useful dressing is a warm spirit lotion kept applied with lint and cedar milk; as suppuration comes on, a linseed-meal poultice, either simple or made with port wine, may be advantageously applied. Most commonly the boils may be allowed to break, when they discharge a thick pus, together with the central core, thus leaving a small cavity in and under the skin, which, however, soon fills up. The surgeon may in some cases find it necessary to open them by a crucial incision when they are large, and do not appear disposed to break of themselves. When the boil commences as a small irritable pustule, it may occasionally be kept back by touching the point of this with nitrate of silver, or with a saturated solution of bichloride of mercury.

CARBUNCLE.

A carbuncle consists essentially of a circumscribed and limited inflammation of the subcutaneous cellular tissue, rapidly running into suppuration and slough. Indeed, the rapid formation of pulpy greyish or ash-coloured sloughs of the cellular tissue is characteristic of the disease, whether resulting from the specific nature of the inflammation, or more probably from the strangulation of the parts by the accumulation of serum and blood consequent on violent inflammatory action in parts the vitality of which has by constitutional depressing causes been previously materially lowered.

SIGNS.—A carbuncle begins as a flat, painful, hard, but somewhat doughy, circumscribed swelling of the integuments and subjacent cellular

TISSUE. It is of a dusky red hue, slightly elevated, but never losing its flattened circular shape; as it increases in size, the skin covering it assumes a purple or brownish-red tint, becomes undermined, and gives way at several points, forming openings through which ash grey or straw-coloured sloughs appear, and from which an unhealthy purulent discharge scantily issues. The size of the swelling varies from one to six inches in diameter; most commonly it is about a couple of inches across. Carbuncles are generally met with on the posterior part of the trunk, more especially about the shoulders and the nape of the neck; being rarely seen anteriorly, or on the extremities. I have, however, had to treat very large carbuncles situated on the abdomen, and have met with them on the shin, forearm, forehead, lips and cheeks.

The *Constitutional Disturbance* attending this disease is always of the asthenic type, the complexion is often peculiarly sallow or yellow, the pulse feeble, and tongue loaded; and if the tumour be large, or be seated on the head, a fatal termination may take place, the patient sinking into a typhoid state.

DIAGNOSIS.—This affection, with many points of resemblance, yet differs from boils in its greater size, in the dusky red of the inflamed integument, in its broad flat character, and in the large quantity of contained slough in proportion to the small amount of purulent discharge. Unlike boils, carbuncle is very rare in young people, and never occurs in robust individuals. Indeed, it is always occasioned by, and is by itself indicative of a broken state of the constitution, being usually met with in individuals of a debilitated and irritable habit of body who have passed the middle period of life, not unfrequently as the result of the depressing influence of chronic exhausting disease, as of saccharine diabetes or albuminuria.

The *Prognosis* in carbuncle will depend on the size of the swelling, on its situation, and on the state of the patient's constitution, more particularly on that of his kidneys. The most dangerous carbuncles are those that are large, and situated upon, or that encroach on, the scalp; in fact, the more this structure is involved the greater the danger. If the constitution be good, even these may be recovered from, but if the kidneys be unsound, or if there be chronic saccharine diabetes, the progress of the disease cannot readily be checked, and the patient will usually sink.

TREATMENT.—*Preventive Treatment.*—In the very early stage of the formation of a carbuncle, it will be found that the disease appears as a small pointed vesicle situated on a hard brawny base. At this period, the further progress of the malady may often be completely arrested by opening the vesicle, and rubbing its interior with a pointed stick of potassa cum calce or nitrate of silver. If the carbuncle have attained a somewhat larger size, I have often seen its extension prevented, and a cure effected, by covering it with a square of soap-plaster spread on thick leather, in the centre of which a hole has been cut to allow the exit of discharges.

The *Constitutive Treatment* must be conducted on the general principles that guide us in the management of low and sloughing inflammations. After the bowels have been cleared out, the patient should be put on stimulants and bark if much depressed, or else the mineral acid and quinine. The latter in large doses, as much as five grains every four hours, is often of great service. Our great reliance is, however, in the free administration of diuretic stimulants and good nourishment. The best medicine in such cases is undoubtedly port wine and porter, given as freely as the patient can take it, with strong beef tea, essence of meat, or turtle soup. The brandy and egg mixture is also especially serviceable.

Local Treatment.—The first question to be determined is as to the propriety of incising a carbuncle. Some surgeons uniformly adopt this plan, others, again, discard it in all cases. I think that either method as an exclusive one is erroneous, but that the most successful treatment consists in allowing the question of *early* incision to be determined by the amount of tension. If this be considerable, nothing gives such immediate and complete relief as an early and free crucial incision, fairly carried through the diseased parts. In this way the constitutional disturbance resulting from the extreme tension is at once removed, the local progress of the disease is checked, and the extension of sloughing by strangulation of the tissues is prevented. In the absence of tension early incision is not necessary, but at a later period it may become requisite, in order to prevent the confinement of pus and sloughs. Stimulating poultices made with insect-meal and port wine, yeast, or beer-grounds, alternated with hot fomentations, should then be freely applied, and the sloughs separated as they loosen. If the action in the part be sluggish, much good will arise from dressing the cut with elemi ointment, creasote, or balsam of Peru. The resulting ulcer, though large, will usually cicatrise rapidly, if treated on ordinary surgical principles.

CHAPTER XXXII.

ERYSIPELAS.

Erysipelas is an affection that so frequently and seriously complicates most other surgical diseases and injuries, that its study is of the utmost importance to the practical surgeon. It usually manifests itself as a peculiar and distinct form of inflammation; as much so as any of the other varieties—the adhesive, the suppurative, the ulcerative, or the gangrenous. *Erysipelas*, or, as it may be termed, the *erysipelatous inflammation*, including all those varieties of this condition that are usually spoken of as “*diffuse*,” has a remarkable tendency to spread or diffuse itself with great rapidity by continuity of surface, to change its seat, and not to be limited by any adhesive action. It may extend itself over any continuous surface, the skin, the cellular tissue, the mucous and serous membranes, and the lining membrane of arteries, veins, and lymphatics, are all liable to be affected by it. Hence, to describe it as a *cutaneous* disease, as has often been done, is in the highest degree incorrect and unphilosophical, and evinces a very limited acquaintance with its true nature. Indeed, not only must we look upon *erysipelas* as a disease that may affect any surface, external or internal, but we must consider the constitutional disturbance that takes place in *erysipelas* as the essential morbid condition. This, it is true, is usually complicated with diffuse inflammation of the integument, and then constitutes one of the ordinary forms of *erysipelas*. But a constitutional fever may occur, of precisely the same type as that which we observe to precede and to accompany the local inflammation, without any such complication. Thus I had especial occasion to observe in a very fatal outbreak of *erysipelas* that took place in one of my wards a few years ago. On that occasion, all the cases in which the cutaneous form of *erysipelas* appeared were marked by severe constitutional disturbance, attended by much gastrointestinal irritation. But precisely the same type of general febrile symp-

toma, and the same irritation of the stomach and bowels, occurred in patients in the same ward in whom no local or surface evolution of the disease took place, as in those affected by the ordinary cutaneous form of it. The true pathology of the diffuse, low, or erysipelatous inflammations has yet to be made out. They are all closely connected with one another, and are evidently blood or constitutional diseases, under whatever name they go. The similarity of causes, of effects, and of constitutional disturbance, makes it probable that they are all essentially dependent on one common condition of the blood; and that the particular local manifestation that occurs, whether it be erysipelas, phlebitis, low cellulitis, or diffuse abscess, is secondary to this, and perhaps in some degree accidental.

A chief characteristic of this erysipelatous fever is its incompatibility with the localisation of any inflammation that may exist at or occur after its invasion; and hence, when it attacks the system, it causes already existing inflammations to assume a diffuse or spreading character, extending themselves over any surface on which they happen to be situated. It is especially apt, in this way, to cause those inflammations to spread which have not already been localised, by the deposit of adhesive matter. Hence, recent wounds are more liable to be affected by it than granulating ones, in which the inflammation has already taken on a plastic character, which requires to be overcome before the diffuse form can set in.

The constitutional fever in erysipelas, although usually at first of the sthenic form, very speedily runs into an asthenic or irritative type, presenting in severe cases the usual typhoid symptoms—a quick feeble pulse, brown tongue, pungent hot skin, and muttering delirium. The disease is truly an affection of debility: it is in consequence of the want of a sufficient degree of power in the part, or in the system, for the deposit of plastic matter, and the limitation of the inflammation by this, that the local affection spreads itself unchecked along the surface it invades. The tendency that invariably exists in erysipelas to the occurrence of sloughing and suppuration of the affected tissues, is a further indication of the asthenic and low character of the disease. This view of the nature of the constitutional disturbance in erysipelas is of great importance in reference to the treatment of the disease, as it demonstrates the necessity of not lowering the patient's powers too much during the early period of the affection, when it often temporarily assumes a truly sthenic character.

Erysipelas is especially apt to become complicated with low visceral inflammation, the membranes of the brain, the bronchi and the lungs, or the gastro-intestinal mucous surface, are commonly implicated in this way; and it is often through these complications that death results.

CAUSES.—Erysipelas may arise from causes existing in the patient himself, or from the conditions by which he is surrounded or to which he is subjected. It commonly originates primarily in want of attention to the hygienic conditions that should surround a patient; and is one of the penalties inflicted by nature on those who neglect those prime requisites of health—temperance and cleanliness, or are incapable of obtaining good food and pure air. Were the laws of hygiene attended to as they should be, erysipelas and the allied diffuse inflammations would scarcely be met with in surgical practice. Some persons appear to be naturally predisposed to erysipelas to so great a degree that the application of cold, or slight stomach-derangement, or a trivial superficial injury, may excite it. This predisposition is most generally acquired by habitual derangement of health, and is especially induced by any of the depressing causes of disease, such as over-fatigue, anxiety of mind, night watching, and habitual disregard of hygienic rules as to diet, exercise, air,

&c. The habit of body, however, in which erysipelas is most frequently met with as a consequence of very trivial exciting causes, is that which is induced by the habitual use of stimulants to excess. It is more especially in that state of the system characterised by an admixture, as it were, of irritability and of debility, in which no plastic lymph is deposited as the result of inflammation, but in which this condition is followed by a rapid tendency to the formation of pus and slough, and to extension of disease in a diffuse form, that erysipelas is so very readily induced. This condition of body is met with amongst the labouring poor, as the result of the privation of the necessaries of life, conjoined with the habitual over-use of stimulants and exposure to the various depressing causes of disease, arising from bad food, impure air, &c. Amongst the wealthier classes it occurs as a consequence of high living, want of exercise, and general indulgence in luxurious and enervating habits.

Some diseased states of the blood appear to predispose, in the highest degree, to the supervention of erysipelas. This is especially the case in diabetes, and in granular disease of the kidneys attended by albuminuria. As a consequence of renal disease, erysipelas will occur idiopathically, or from the most trivial causes; a scratch, the sting of an insect, or any of the minor operations in surgery, more especially about the lower part of the body, will occasion it. And not only is it readily induced in this way, but it will extend in an uncontrollable manner in these states of the system, there being apparently in them an utter want of limiting or reparative power in any inflammation, however set up. So also persons of a gross and plethoric habit of body, with a tendency to gout, are predisposed to the occurrence of erysipelas. The blood-degeneration that occurs as a consequence of malignant diseases peculiarly disposes to erysipelas, which accordingly more frequently takes place after operations on persons having such diseases than after the removal of simple tumours.

Amongst the circumstances that surround the patient, and that tend to the production of this disease, *season of the year* and *atmospheric changes* exercise a marked influence. Not only is erysipelas much more frequent in the spring and autumn than at other seasons of the year, but we not unfrequently find it coming on suddenly on the setting-in of cold easterly winds, or on the occurrence of sudden atmospheric vicissitudes. So also erysipelas often assumes an *epidemic* character, as the result of these peculiar but, at present, inexplicable conditions of the atmosphere, in which disease generally assumes a low type, and in which epidemic catarrhs, influenza, phlebitis, and other allied affections, prevail. Epidemic erysipelas is almost invariably of a low form, and is very commonly associated with some peculiar train of visceral complication that distinguishes the particular outbreak of the disease.

But not only is erysipelas epidemic; it is also *contagious*. The contagion of erysipelas, after having been repeatedly denied, can I think no longer be contested. Travers, Copland, Bright, Nunneley, and others, have adduced cases in proof of its contagious character; and instances have repeatedly fallen under my own observation, in which erysipelas, often unfortunately of a fatal form, has been communicated to the servants, nurses, or relatives of patients affected by it. A remarkable proof of the contagious nature of erysipelas occurred in the winter of 1851, in one of my wards at University College Hospital. The hospital had been free from any cases of the kind for a considerable time, when, on the 15th of January, at about noon, a man was admitted under my care with gangrenous erysipelas of the legs, and placed in Brundrett Ward. On my visit two hours after his admission,

ordered him to be removed to a separate room, and directed the chlorides to be freely used in the ward from which he had been taken. Notwithstanding these precautions, however, two days after this, a patient, from whom a necrosed portion of ilium had been removed a few weeks previously, and who was lying in the adjoining bed to that in which the patient with the erysipelas had been temporarily placed, was seized with erysipelas, of which he speedily died. The disease then spread to almost every case in the ward, and proved fatal to several patients who had recently been operated upon. In several instances patients were affected with the constitutional symptoms without any appearance of local inflammatory action, but characterized by the same gastro-intestinal irritation that marked the other cases.

Erysipelas may not only spread in this way from patient to patient, but any diffuse inflammation, as phlebitis, inflammation of the absorbents, low or puerperal peritonitis, and pyæmia, may give rise to external erysipelas, and in its turn be occasioned by it—a strong argument in favour of the allied nature of all these affections. Then, again, the contact of dead or putrescent animal matters with recent wounds may occasion it. In this way the disease is not unfrequently originated in hospitals by dressers going direct from the dead house, and especially from the examination of the bodies of those who have died of diffuse inflammation, to the bedside of patients without taking sufficient care to wash their hands or change their clothes. For this reason also it is of great consequence that the same instruments be not used for practising operations on the dead, and performing them on the living body. Overcrowding of hospitals, and want of proper ventilation in wards or rooms, are fatal sources of erysipelas, and of the allied low inflammations; in fact, I believe that an outbreak of erysipelas might at any time be induced in this way.

The principal exciting cause of erysipelas, is certainly the presence of a wound. It is chiefly recent wounds, however, that are affected by it; when once the adhesive or suppurative inflammation is set up, the wound is not so liable to take it on unless it be in bad constitutions, the formation of limiting line appearing to lessen the liability to the occurrence of the disease. When erysipelas is epidemic, it is well for the surgeon not to perform any operation that can conveniently be postponed until it is less rife; and in no case should a patient on whom an operation has recently been performed be put in a neighbouring bed to a case of erysipelas, or even in the same ward. The size of the wound has little influence on the occurrence of erysipelas, which takes place as readily from a small as from a large one. The more severe forms of erysipelas, however, chiefly occur in those cases in which the fasciæ of the limbs are opened up, when the disease may spread through the deeper intermuscular planes of cellular tissue. Injuries about the head and hands are those that are most liable to be followed by this disease.

But though we must constantly bear in mind the constitutional nature of erysipelas, it will be more convenient and practical to describe it as it affects different tissues and organs. With this view, we may divide it primarily into External and Internal Erysipelas.

EXTERNAL ERYSIPELAS.

By *External Erysipelas* is meant that variety of the disease which affects the skin and subcutaneous cellular tissue. This form of the affection has been described with an absurd degree of minuteness, so far as the transitory and accidental characters of its duration, shape, and appearance are concerned, by many of the writers on the Diseases of the Skin; who, in their anxiety to record minute and often accidental shades of difference in appearance, have

entirely lost sight of the true nature of the disease. The division adopted by Lawrence into the *Simple*, the *Edematous*, and the *Phlegmonous* form, is a practical arrangement that is commonly adopted by surgeons. I prefer, however, and shall adopt, the division made by Nunneley in his very excellent work on erysipelas, as founded on the true pathology of the affection. He arranges external erysipelas under, 1. the *Cutaneous*; 2. the *Cellulo-cutaneous*; and, 3. the *Cellular* varieties.

1. **CUTANEOUS ERYSIPELAS** is the slightest form of the disease, implicating merely the skin; it comprises many of the species of *erythema* of different writers, and corresponds to the *simple erysipelas* of Lawrence.

Local Signs.—A patient is seized with rigors, alternate chills and flushes, followed by headache, nausea, a quick pulse, a coated tongue, and hot skin. In from twenty-four to forty-eight hours the rash appears, though sometimes it comes out simultaneously with the constitutional disturbance. If there be a wound, the secretions of this dry up, and the margins become slightly swollen, and affected by the red blush. If the disease occur idiopathically without a wound, it most commonly appears upon the face, next upon the legs, and lastly upon the trunk. The rash is of a uniform but vivid rose-red hue, sometimes becoming dusky, and always disappearing on pressure; it usually fuses away into the colour of the healthy skin, but is sometimes distinctly margined. It is accompanied by some slight cedematous swelling, which is often considerable where the cellular tissue is loose, as in the eyelids and scrotum, and there is usually a stiff burning sensation in the part. Vesicles or blebs often form, containing a clear but hot serum, which speedily becomes turbid, and dries into brawny desquamation. The redness may spread rapidly along the limb or trunk, or, if the face be affected, travel quickly from one side to the other, causing such swelling of the eyelids as to close them, and giving rise to much tensile pain in the ears. Sometimes the disease disappears in one part of the body, reappearing in another. That which is the *erratic erysipelas*, is often a dangerous form of the affection, occurring in advanced stages of pyæmia, and indicating the approach of death. In these varieties of idiopathic erysipelas, Arnott states that the fauces are always involved. This affection usually disappears without inducing any serious mischief in the part affected, but in some cases assumes a form, more especially in the loose cellular tissue of the neck and of the eyelids. In other cases, cedema of the part continues, with some irritability and redness of the skin and peeling of the cuticle; and in some rare cases the simple erysipelas seems to take on a gangrenous or sloughing character, especially about the umbilicus and genitals of young children.

The *Constitutional Symptoms* of the cutaneous or simple erysipelas present every variety between the sthenic and asthenic forms of inflammatory fever. When the disease occurs in London, it certainly most frequently assumes a low type. There is also in most cases a good deal of derangement of the digestive organs; the tongue being much coated, with tenderness about the epigastrium, dark offensive evacuations, and not unfrequently diarrhoea. When the scalp is affected, severe headache, with symptoms of cerebral inflammation, are commonly met with. Most frequently recovery takes place by the gradual subsidence of the symptoms; this form of the disease seldom proving fatal unless the scalp be affected, and the brain consequently implicated.

2. **CELLULO-CUTANEOUS OR PHLEGMONOUS ERYSIPELAS** differs from the last variety in the degree of inflammation, and in the depth to which the tissues are affected. The intensity of this form of inflammation is such as invariably to terminate, if left to itself, in diffused suppuration and sloughing of

the tissues. In depth it invariably extends to the subcutaneous cellular tissue, and, though generally bounded by the fasciæ lying beneath this, not unfrequently implicates them if they have been opened up, extending to the intermuscular cellular planes, the sheaths of the tendons, and other deep structures of the limb or part.

Local Signs.—The cellululo-cutaneous or phlegmonous erysipelas is ushered in by the ordinary symptoms of inflammatory fever, accompanied or followed by the signs of severe inflammation in the part affected. The redness is uniform, of a deep scarlet hue, and pretty distinctly bounded; the pain is from the first pungent and burning, though it may soon assume a throbbing character; the swelling, at first soft, diffused, and admitting of distinct pitting, soon increases, and becomes tense and brawny, the skin being evidently stretched to its full extent, and the limb appearing perhaps to be double its natural size. Large vesications or blebs containing sero-purulent fluid, sometimes of a sanious tinge, make their appearance in many cases. This is the condition that usually continues up to the sixth or eighth day after the invasion of the disease, during the whole of which time the constitutional symptoms have presented the ordinary type of athenic inflammatory fever; about this time, however, a change commonly takes place, either for better or worse. If, under the influence of proper treatment, and in a tolerably healthy constitution, the inflammation subside, resolution takes place, with a gradual abatement of all the symptoms. If, however, as usually happens, the disease run on to more or less sloughing or suppuration of the part, no increase of the swelling, pain, or redness takes place, but, on the contrary, some diminution of these signs may occur, giving rise to an apparent, though deceptive, amendment in the patient's condition. The skin becomes darkly congested, and the part, instead of being tense and brawny, has a somewhat loose, soft, and boggy feel, communicating a semi-fluctuating, doughy sensation to the fingers. This change from a tense brawny state to a semi-pulpy condition is indicative of the formation of pus and slough beneath the integument, and should always be anxiously watched for by the surgeon. It must be remembered that it occurs without any material change in the size, the colour, or the general appearance of the part, but can only be detected by careful palpation of it; hence the surgeon must daily examine with his own fingers the state of the parts inflamed, and neither trust to the reports of others, nor to the general appearance of the diseased structures, for the probable condition of the subjacent tissues. If an incision be now made into the affected part, the cellular membrane will be found loaded with an opalescent fluid distending its cells, but not flowing from the wound; the retention of this fluid in the cellular tissue gives a gelatinous appearance to the sides of the incision, which rapidly degenerate into slough and pus. If the alteration in structure have advanced to a stage beyond this, the cellular tissue will be found to have been converted into dense masses of slough, lying in the midst of thin and unhealthy ichorous pus; these have not inaptly been compared in appearance to masses of decomposed tow, of wet chamois leather, or to the membranes of a fœtus a few months old. Whilst these changes are going on below the surface, the skin, at first congested, becomes somewhat paler, and assumes a white or marbled appearance, rapidly running into black sloughs, and being undermined to an immense extent by large quantities of broken-up cellular tissue and of ill conditioned pus, without any appearance of pointing, however extensive the subcutaneous mischief may be. These destructive changes expose muscle, fasciæ, and blood-vessels, and may induce necrosis of the bones or destroy the joints. They occur most readily in those parts of the

body that possess the lowest degree of vitality, and hence are more common in erysipelas of the legs than in the same affection of the scalp. If the patient recover, there will be tedious cicatrization of the deep cavities that are left, or considerable cedema, often of a solid character, a kind of tissue hypertrophy of the part, which may continue for some considerable time. In other cases, again, there may be such extensive local destruction or gangrene of the soft tissues, with exposure and death of the bones or suppuration of the joints, that amputation of the limb may be required as a means of saving the patient's life. No operation of this kind, however, should ever be practised for the consequences of erysipelas, unless these be strictly localised, with no tendency to spread, nor until specific constitutional fever has been completely removed, except such as is of a hectic character, and dependent on the exhausting influences of the suppuration and disorganization of the tissues.

During the progress of these local changes, the *Constitutional Symptoms* have assumed corresponding modifications. At first of an active inflammatory character, the fever, when suppuration and sloughing have set in, often suddenly assumes an asthenic form; although in some cases there is no diminution in the severity of the symptoms, until, after an attempt for a few days to bear up against the exhausting influence of the disease, the constitution gradually gives way and death speedily supervenes. If the patient survive the stage of sloughing, and if the discharge continue abundant, hectic with diarrhoea, gastro-intestinal irritation, metastatic abscesses or pyæmia, may carry him off. If recovery eventually take place, it may be at the expense of a constitution impaired and shattered for years. This disease is most dangerous in the old and infirm, or in young children. The immediate danger is always greatest when the head is affected, from the extension of the disease to the membranes of the brain, and the superposition of erysipelatous arachnitis. The remote danger from the effects of suppuration, necrosis, and inflammation of the joints, is greatest when the lower extremities are the seat of erysipelas.

A variety of the cellululo-cutaneous erysipelas has been described as *Edematous Erysipelas*. By this is meant not merely that effusion into the cellular tissue which occurs in all the varieties of the disease, but a peculiar form, specially marked by oedema of the cellular tissue, with less inflammation of the skin than usual. There is much swelling, which pits deeply, with but little pain or tension, and but moderate redness of the skin; the constitutional symptoms are less marked than in the other varieties of the disease. It is principally met with in old people, or in persons of a dropsical tendency, in whom it occurs especially about the legs, scrotum, or labia, sometimes giving rise, by the effusion of a sero-plastic fluid, to permanent and solid enlargement of these parts.

3. *CELLULAR ERYSIPELAS*, or, as it is often termed, *Diffuse Inflammation of the Cellular Tissue*, or *Cellulitis*, has been particularly described by Duncan, Arnott, Lawrence, and Nunneley. It always arises from a wound or injury, often, however, of an apparently trivial character, and most commonly affects the subcutaneous cellular membrane, though occasionally it extends to the subaponeurotic tissue, and then is a more severe and dangerous affection. Though commonly arising as a consequence of ordinary injuries, it is especially apt to follow those in which there has been any inoculation of animal poisons, as dissection-wounds, the stings of insects, and the bites of venomous reptiles. In whatever way arising, it is characterised by the rapidity and extent of the sloughing of the affected tissue, and by great depression of the powers of the constitution. That the diffuse inflammation

of the cellular tissue, whether it be limited to a finger, or implicate the cellular membrane of half the body, is a variety of erysipelas affecting this membrane primarily, and the skin secondarily, there can be no doubt. The points of resemblance between cellulitis and erysipelas have been well shown by Nunneley. Not only are the local effects precisely the same in the two diseases—the same swelling, tension, infiltration of pus, and formation of gangrenous shreds and sloughs; but the constitutional symptoms, though differing perhaps in degree, present no variety as to character. The results also are identical, there being the same local impairment of structure, the same tendency to involve parts at a distance, and to the formation of secondary abscesses. So also these two diseases occur in the same constitutions, in the same states of the atmosphere, and in the same situation; one form of disorder may produce the other; and, lastly, the same treatment is required for both affections.

Local Signs.—These are great swelling, tension, and pain in the limb, which feels brawny in some parts, oedematous in others. The skin, which is slightly reddened in patches, has a mottled appearance, and speedily runs into blackish sloughs. The extent to which the disease may spread varies greatly; when once it has set in, it commonly runs rapidly up the whole of a limb, extending also to the sides of the trunk; in other cases, its violence appears to be principally expended at a distance from the seat of injury; thus, in a case of a punctured wound of the finger, the diffuse inflammation may principally take place in the extended planes of cellular tissue about the axilla and sides of the chest. It is important to bear in mind that this form of erysipelas sometimes affects the internal planes of cellular tissue. This may happen, for instance, in the fasciæ of the pelvis after lithotomy, or in the anterior mediastinum after operations at the root of the neck. The sloughing often occurs with remarkable rapidity in the course of thirty-six or forty-eight hours, the cellular membrane being broken down into ill-conditioned pus and shreddy sloughs, more especially when the disease has resulted from the inoculation of an animal poison. Death may in such cases occur in two or three days; in other instances, again, several weeks elapse before a fatal result declares itself.

The *Constitutional Symptoms* are those of asthenic fever in the most marked degree; a quick and feeble pulse, brown tongue, and muttering delirium, being early concomitants of this affection.

Diagnosis.—The diagnosis of the various forms of erysipelas is generally easily made. From the *exanthemata*, it is distinguished by the character of the eruption, its limited extent, and usual complication with injury. From *inflammation of the veins*, or of the *absorbents*, the diagnosis is not always so easy, more especially as the two conditions frequently co-exist. If it be a vein that is inflamed, the general absence of cutaneous redness, the existence of a hard round cord, and the tenderness along the course of the vessel, are sufficient to establish the diagnosis. In inflammation of the absorbents, the redness will be found not to be uniform, but to consist of a number of small and separate red streaks, running in the direction of the lymphatics, and affecting the glands towards which they course. These two affections, however—erysipelas of the skin and inflammation of the absorbents—are almost invariably conjoined; hence a definite diagnosis is not of much importance.

Prognosis.—The prognosis in any case of erysipelas depends on a variety of circumstances. The form of the disease influences greatly the result; the cutaneous variety being attended with least danger, the cellular with the most. The traumatic is more dangerous than the idiopathic form. Much,

however, depends on other circumstances, such, for instance, as the seat of the affection: that attacking the head and lower limbs being the most dangerous, encephalitis being apt to ensue, when the head is affected. When the legs are extensively implicated, sloughing of the skin and cellular tissue, with denudation of the bones and destruction of the joints, may occur. The disease, in all its forms, is most dangerous at either of the extremes of life. The previous state of health of the patient also influences greatly the result. If the constitution be sound, very extensive mischief may be recovered from; if on the other hand, it be depressed or broken by want of the necessaries of life, by fatigue, over exertion, or indulgence in stimulants, a very slight amount of disease may probably prove fatal. The most dangerous complication of erysipelas, and one which when it exists almost precludes the hope of recovery, is a granular state of the kidneys with albuminuria. I have never seen any patient labouring under this disease, and attacked with traumatic erysipelas, escape with life; the sloughing and suppuration running on unchecked by any treatment that could be adopted. The particular type which the erysipelas may assume, and the occurrence of gastro-intestinal or pulmonary complications, will also seriously affect the result.

TREATMENT. — Preventive Measures. — The occurrence of erysipelas is best guarded against by attention to hygienic measures, more particularly to proper ventilation with pure air, and the avoidance of overcrowding of patients. In hospitals, erysipelas may be produced at will by want of attention in these respects, and it will usually be found that the persistence of erysipelas in certain wards, or even its repeated appearance in certain beds, is owing to some local cause, such as the emanations from a drain, on the removal of which the disease will cease. Scrupulous attention to cleanliness also on the part of nurses and dressers should be enforced, and the latter should not be allowed to go straight from the dead-house to the ward without previously washing their hands in some chlorinated solution. When erysipelas has already occurred, its further spread may be prevented by isolating the patients affected, and at once taking active measures to purify the ward from which they have been removed.

The Curative Treatment of erysipelas must always be conducted with reference to the low character of the local inflammation, its tendency to run into suppuration and gangrene, the asthenic type that the constitutional fever readily assumes, and the frequent complication of visceral inflammations of a congestive form. The apparent intensity of the local inflammation must not lead the surgeon into the fatal error of employing an over-active antiphlogistic treatment, more particularly if the disease be epidemic, when it always assumes a low type. In the treatment of this affection it is especially important to look to the future, and to remember that, if active depletory measures be employed early with a view of lessening the present disease, it will be at the risk of inducing more extensive sloughing, and perhaps of lowering the patient's powers to such a degree as to prevent his bearing up under the depressing influence of the consequences of the disease.

In the Treatment of Cutaneous or Simple Erysipelas, we must in the first instance clear out the stomach and bowels by an ipecacuan emetic, followed by a calomel and colocynth pill and some saline aperient. If the patient be young and robust, and the disease be of a somewhat sthenic character, he should be kept on a mild diet, and have diaphoretic salines administered every fourth or sixth hour. If the patient be advanced in years, and the disease assume a lower form, the acetate of ammonia in camphor mixture may be administered. If the disease from the first assume a low type, or if a

subside into this, the carbonate of ammonia in ten grain doses should be added to the preceding mixture, in which the decoction of bark may then be substituted for the camphor julep. In many of the low forms of erysipelas, medicines are not well borne by the patient, the stomach rejecting them, and then I have seen the best possible results follow the free administration of the brandy-and-egg mixture, to which I am in the habit of trusting in the majority of these cases. During the progress of the disease, simple purgatives must be given from time to time. In individuals of an anæmic and cachectic habit of body, no remedy exercises so beneficial an influence as the tincture of sesquichloride of iron. This should be administered in doses of twenty minims every third or fourth hour.

The *Local Treatment* of this, as of every variety of erysipelas, is of equal importance with the constitutional management. Warm applications assiduously continued, especially poppy and chamomile fomentations applied by means of flannels or spongio-piline, afford the greatest possible relief. Cold lotions should never under any circumstances be employed; they not only act injuriously by lessening the vitality of the part, and thus favour local sloughing, but they may chance to cause a retrocession of the disease, and the consequent affection of some internal organ. The local abstraction of blood and of serum from the inflamed part, by the plan introduced by Sir R. Dobson, of rapidly making with the point of a lancet a large number of small punctures, from a quarter to half an inch deep, is of much value, by lessening the tension and swelling, and consequently diminishing the inflammatory action; a warm fomentation cloth or poultice should be laid over the punctures so as to encourage bleeding, and the escape of serum. Astringent applications to the inflamed surface, such as a strong solution of the nitrate of silver, are recommended by some surgeons. I have seen them pretty extensively employed by the late Dr. A. T. Thomson, but not with any very marked success. A boundary line of nitrate of silver is occasionally drawn around the inflamed part, with the view of checking the extension of the disease. I have often done this, and seen it done by others, but never apparently with any benefit; and have now discontinued the practice as an useless source of irritation. The application of a bandage is occasionally necessary after the disappearance of the erysipelas, in order to remove the ædema that remains.

In the *Treatment of Cellulo-cutaneous Erysipelas*, more energetic constitutional and local means are required. In the early stage of the disease, our object is to prevent the inflammation from running into gangrene of the affected tissue. The fever being at this period commonly of a sthenic character, the more active administration of purgatives, antimonials, or effervescent salines is required. I have never seen a case in which blood-letting is required; and depressing remedies, such as salines, should be given with great caution. The best plan is, perhaps, to give an emetic and purge, to clear out the stomach and bowels, and then to give effervescent salines, with carbonate of ammonia, in full doses of gr. x. to gr. xv. As the disease advances, and symptoms of more or less depression come on, it may be necessary to effect that gradual change to a more stimulating plan of treatment, which has already been described in speaking of the management of inflammatory fever. In doing this, the pulse and the tongue must be our guides, as the one becomes feebler and the other browner, so must ammonia, bark, and especially port wine, and the brandy-and-egg mixture, be administered. In the more advanced stages of the disease, when sloughing and suppuration are fully established, our sole object must be by nourishing diet, and the use of stimulants and tonics, more particularly the tincture of

sesquichloride of iron, to bear the patient through the depression and subsequent hectic that ensue.

The *Local Treatment* of cellulito-cutaneous or phlegmonous erysipelas must be conducted on essentially the same plan as that of the cutaneous variety, though with the employment of more active means. The part affected must be kept at rest, must be elevated if it be a limb, and have hot chambrée and poppy fomentations assiduously applied, cold being more prejudicial here even than in the last form of the disease; in this way, the swelling and tension may perhaps be removed, and the sloughing of the cellular tissue prevented. In the majority of cases, however, other means will be required to effect this, and with this view none are more efficacious than incisions made into the part; by these an outlet is afforded for the blood and effused serum, which, by distending the vessels and cells of the part, produce strangulation of its tissues and consequent sloughing. This mode of practice, originally introduced by Mr. Hutchinson, is generally allowed to be the most effectual means we possess for the prevention of sloughing; hence the incisions should be made early, before there has been time for the tissues to lose their vitality. So soon, indeed, as they have become tawny, indurated and tense, incisions properly made and placed will afford the greatest possible relief to the part and the patient, taking down the tension by the gaping, and the swelling by the exit they afford to blood and serum. Much difference of opinion has existed among surgeons, as to the extent to which incisions should be practised in these cases; some recommending that one long cut should be made through the inflamed structures, others contending, on the contrary, that a number of small incisions better answer the proposed end. The objections to the long incision are, that so considerable a wound not only inflicts a serious shock upon the system, but that the loss of blood from it is often so great as to be of serious, and even of fatal consequence to the patient—cases having occurred in which life has been lost from this cause, or the hemorrhage has been arrested only by the ligation of the main artery of the limb; and also that a single long incision does not relieve tension so effectually as a number of smaller ones. The incisions consequently should be of limited extent, from two to three inches in length: at most they should not extend deeper than into the gelatinous-looking subcutaneous cellular tissue, unless it happen that the disease have extended beneath the fascia, when they may also be carried through it. Mr. South recommends that the incisions should be so arranged in fours, as to enclose a diamond-shaped space, and states that in this way the greatest relief is given to the tension of the part. After the incisions have been made, the part should be well poulticed and fomented, so as to facilitate the escape of serum. As it is not the object of the surgeon to draw blood in these cases, any undue amount of hemorrhage should be arrested by plugging the wound. After suppuration and sloughing have taken place, as indicated by a boggy feel of the parts, free incision should be made in order to let out pus and sloughs. After this the skin will often be found to be greatly undermined, blue, and thin, with matter bagging in the more dependent parts; if so, egress must be made for it by free counter-openings. During the after-treatment, frequent dressing is necessary to prevent an accumulation of pus, and the sloughs must be removed as they form. Care should be taken not to destroy any of the vascular connections of the skin with subjacent parts; but, in order to get proper cicatrisation, it will often be found necessary to lay open sinusses, or to divide bridges of unhealthy and blue integument stretching across chasms left by the removal of the gangrenous cellular tissue. If the loss of sub-

stance be great, the cicatrix that forms may be weak, imperfect, or so contracted as to occasion great deformity of the limb. In other cases, again, the diseased state of the bones and joints may be such as to call for ultimate amputation, either in consequence of the local deformity and annoyance, or in order to free the constitution from a source of hectic and of irritation. Under all circumstances, the patient's health will usually continue in a feeble and shattered state for a considerable time after recovery from this form of erysipelas, requiring change of air and great attention to habits of life, a nourishing diet, &c.

In the *Treatment of Cellular Erysipelas*, it is usually necessary to administer stimulants early; ammonia, wine, or brandy may be required from the very first. The surgeon must judge of this by the constitutional condition of the patient, and more particularly by the state of his pulse and tongue. The *Local Treatment* is precisely of the same kind as that adopted in phlegmonous erysipelas, except that the incisions require to be made earlier and perhaps more freely; in all other respects, there is no difference between the general management of the two forms of the disease.

SPECIAL FORMS OF EXTERNAL ERYSIPELAS.—*Erysipelas of Newly-born Infants* is occasionally met with, more particularly in lying-in-hospitals, or in situations where the mother and child are exposed to depressing causes of disease. It usually makes its appearance a few days after the birth, at first about the abdomen and genitals, but spreads rapidly over the whole of the body, being characterised by a dusky redness, which rapidly runs into gangrene of the affected tissues. It has been supposed to arise from inflammation of the umbilical vein, or of the umbilicus itself. It is an extremely fatal affection, owing to the feeble vitality of the child, and presents but few grounds for treatment; change of air and of nursing, with the administration of a few drops of spirits of ammonia or brandy from time to time, being all that can be done.

Erysipelas of the Orbit may occur primarily, or as the result of extension of the morbid action from the neighbouring structures. It is a dangerous and often fatal affection, from the occurrence of encephalitis. It commences with a violent deep-seated pain at the base of the orbit; the conjunctiva becomes injected and ecchymosed, the eyelids are greatly swollen, red, and oedematous; the eyeball protrudes, and vision is disturbed or lost. Symptoms of cerebral inflammation now set in, and the patient often sinks, comatose.

The *Treatment* consists in fomentations, with early and free incisions into the orbit, made by pushing a lancet flat-wise between the eye-ball and the orbital walls, through the inflamed conjunctiva, the eyelids having previously been everted. In this way inflammatory effusions and possibly pus may be evacuated. Destructive abscess of the orbit, possibly of an erysipelous origin, occasionally occurs in the puerperal state, requiring, when practicable, the free evacuation of the pus, in the way just mentioned.

Phlegmonous Erysipelas of the Head is of very frequent occurrence from slight injuries or operations about the scalp and face, more particularly in elderly people and those of unhealthy constitution. In this form of erysipelas there are two special sources of danger; one is sloughing of the occipito-frontalis muscle, the other, inflammation of the membranes of the brain. The occipito-frontalis rarely sloughs, except in cases of traumatic erysipelas of the head. It then loses its vitality in consequence of the suppuration of the deep plane of cellular tissue lying between it and the cranium, and the encephalitis occurs apparently by the extension of the inflammation inwards.

The *Prognosis* of erysipelas of the head often will greatly depend upon

whether it is traumatic or idiopathic. When arising from wound, it is very commonly fatal; when it is idiopathic, it is very seldom indeed followed by death. This difference in the termination of the two varieties of the disease is owing, I believe, to the great tendency to suppuration and deep sloughing of the scalp in cases of wound, and the infrequency of this occurrence when there is no breach of surface.

In the *Treatment* of this affection, active antiphlogistic means are more frequently required than in the management of other forms of erysipelas. But in very many, perhaps I may say in the majority of instances, the disease will be associated with more or less asthenia, and then the tonic and stimulating plan of treatment will be attended by the best results. With the view of preventing sloughing of the muscles, a free crucial incision should be made through the scalp down to the bone, the head, of course, having been shaved at the onset of the disease. Bagging of matter must be prevented by free counter-openings, and the application of pads and bandage wherever it is likely to occur. However much the scalp may be undermined, or the bones of the cranium exposed, adhesion usually takes place, and the vitality of the parts is preserved.

Erysipelas of the Scrotum, the "inflammatory cedema," so well described by Liston, is of frequent occurrence, as the result of wounds, ulcers, and other sources of irritation in this neighbourhood. In this affection the scrotum swells to a large size, being uniformly red, but with a semi-transparent glossy appearance, pitting readily on pressure, and feeling somewhat soft and doughy between the fingers; the integuments of the penis are also greatly swollen and cedematous, and sometimes the inflammation extends to the cellular tissue of the cord. The chief characteristic of this form of erysipelas is its tendency to run into slough without any previous brawny or tense condition of the parts; the dartos becoming so distended with sero-plastic fluid that the circulation through it is arrested, and its tissue loses its vitality. When an incision is made into it in this state it scarcely bleeds, and the sides of the wound present a yellowish-white gelatinous appearance.

The *Treatment* of erysipelas of the scrotum is simple; it consists in making a free incision about four inches in length from behind forwards on each side of the septum, taking care, of course, not to go so deep as to wound the testes; the part must then be supported on a pillow, and well poulticed and fomented. If this incision be not made at once, a great part, or even the whole of the scrotum, may slough away, leaving the testes and cord bare; under these unpleasant circumstances, however, the parts will often with great rapidity cover themselves with a new integument. The cedema of the penis usually subsides of itself, or by making a few punctures in it; should its integuments, however, threaten to slough, a free incision must be made into it, or the prepuce be slit up.

Erysipelas of the Pudenda is occasionally met with in ill-fed unhealthy children in whom cleanliness is neglected. The parts become of a dusky or livid red, swell considerably, and quickly run into gangrene, which spreads up the abdomen or down the nates. It may prove fatal by inducing peritonitis or exhaustion. In the *Treatment*, ammonia, bark, and the chlorate of potass, with good nourishment, and a little wine, are the principal means to be employed, at the same time that yeast or chlorinated poultices are applied locally.

Erysipelatous Inflammation of the Fingers, or, as it is commonly called, *Furrow*, is a frequent affection in old and in young people, either occurring spontaneously in cachectic constitutions, or arising from the irritation pro-

duced by scratches, punctures, or the inoculation of the part with poisonous or putrescent matters. It is most common in the spring of the year, when, indeed, at times it appears to be epidemic, large numbers of persons suffering from it without any very apparent local cause.

That whitlow is truly an erysipelatous affection of the fingers, appears to be the case for the following reasons. 1. The causes, whether of season, infection, or local irritation, are the same in both affections. 2. The constitutional disturbance is always very severe for so slight a disease, and assumes the same character of speedy depression that we observe in erysipelas. 3. The inflammation of the affected finger is invariably diffuse, never being bounded by adhesion, but always tending to terminate in suppuration and sloughing. 4. So soon as the disease spreads beyond the affected finger, or to the back of the hand, it assumes a distinctly erysipelatous appearance and character.

The inflammation of whitlow is in many cases confined to the pulp of the finger, commencing in the dense cellulo-fibrous tissue forming this, and often arising from a very slight injury, as the prick of a pin or splinter, but not unfrequently without any traumatic cause. The part becomes extremely painful, hard, red, and swollen: it then suppurates to a limited extent, with some sloughing of the cellular tissue. In many cases the ungual phalanx, which is embedded in the cellulo-fibrous digital pulp, necroses when this sloughs. There is usually some inflammation of the lymphatics of the arm accompanying this affection, and not unfrequently a good deal of constitutional fever and irritation.

In the more severe cases of whitlow, the inflammation, which is of an excessively painful character, owing probably to the tension of the parts, extends to the sheaths of the tendons, and then constitutes an affection that is fraught with danger to the utility of the finger or hand. In these cases the whole finger swells considerably, becomes red and tense, with much throbbing and shooting pain; the inflammation rapidly extends to the back of the hand, which becomes puffy, red, and swollen, presenting the ordinary characters of erysipelas. Although the palm be greatly swollen, it usually preserves its natural colour, or becomes of a dull white, owing to the greater thickness of the cuticle in this situation. Pus rapidly forms, both in the finger and hand, and, finding its way into the sheaths of the tendons, will spread up the forearm under the annular ligament. There is usually no fluctuation to be felt in the finger, even though pus may have formed, but in other parts of the hand it may readily be detected in the usual way. In these cases there is always much sloughing conjoined with the suppuration: the cellular tissue of the finger and hand, the tendons or their sheaths, and the palmar fascia, being all more or less implicated. In many cases the joints of the fingers are destroyed, and the phalanges necrose; or, if this do not happen, the tissues of the part may be so matted together as the result of sloughing and suppuration, that rigid and contracted fingers, or a stiff and comparatively useless condition of the hand, may be permanently left.

In the *Treatment* of this affection, the patient should be well purged, and kept upon a strictly antiphlogistic plan during the early stages. At the same time the inflamed finger should be freely leached, and then alternately fomented and soaked in very hot water for twenty-four or forty-eight hours, being kept during the whole of this time in an elevated position. In this way the inflammation may be sometimes cut short at its onset; should it, however, continue to progress, the finger becoming hard, with much throbbing, a free longitudinal incision must at once be made along each side of it, so as to relieve tension and prevent sloughing; this, though a painful procedure,

should never be omitted, on account of the importance of the preservation of the full utility of the part. The incision is best made from the proximal towards the distal end of the finger, so that, if the patient make an attempt to withdraw the hand during the operation, he will rather facilitate than hinder being made than otherwise. In making these incisions, however, the sheaths of the tendons should, if possible, be avoided, if these be opened, the tendons will probably slough, and the finger be left in a permanently extended and rigid state. The finger must then be well soaked in hot water, and poulticed. In this way the inflammation may be arrested, and sloughing happily prevented; should, however, matter have formed, this must be let out as it accumulates, and all hardened and sodden cuticle peeled from the part. After the opening has been made, and any slough which may have formed has come away, it not unfrequently happens that a large and fungus granulating mass sprouts up; this will, however, gradually subside, as the swelling of the finger goes down and the inflammation abates. If the nail become loosened, it had better be removed, as it may otherwise keep up irritation; it must not, however, be torn off if adherent, but merely scraped and cut away so far as loose. When the whole of a finger is affected, the hand should be placed on a pasteboard splint as soon as the inflammation has been somewhat subdued, lest contraction of the affected finger ensue, which may eventually extend to the neighbouring ones.

When the joints are implicated, destruction of the cartilages commonly ensues; yet, by position, and rest on a splint, a tolerably useful though stiffened finger may be left. When the bones are implicated, some operative procedure usually becomes eventually necessary. If the ungual phalanx alone be necrosed, it may be excised through an incision on the palmar side of the finger, the pulp and nail being left; in this way I have often preserved a finger that must otherwise have been removed. Amputation of the finger at the metacarpo-phalangeal articulation will usually be required when the second or proximal phalanges are involved; though here, partial operations by cutting and scraping away the diseased bone, may sometimes be usefully done. During the later stages of these affections, tonics, good diet, and stimulants will be required for the re-establishment of the health.

INTERNAL ERYSIPELAS.

By *Internal Erysipelas* is meant those forms of diffuse inflammation which affect the Mucous or Serous Surfaces, or the Lining Membrane of Arteries, Veins, and Lymphatics.

ERYSIPELAS OF MUCOUS SURFACES.—The mucous surface that is chiefly affected by this disease is that covering the fauces, the pharynx, or the larynx.

Erysipelas of the Fauces may occur in consequence of the disease spreading from the head and face to these parts; or it may commence as a primary affection, occurring perhaps at the same time that the rash appears on the cutaneous surface on some distant part of the body. When the fauces are erysipelatous, they present a bright crimson or scarlet colour, with some swelling and thickening of the soft palate and uvula; there is also most commonly some huskiness or complete loss of voice, and occasionally some croupy symptoms. At the same time there is a good deal of low constitutional fever, with a pungent, hot skin, and quick pulse. This form of erysipelas is of a peculiarly contagious character, and occurs not unfrequently in the attendants of those who are labouring under some of the other varieties of the disease; of this I have seen numerous instances. In many

cases, also, it is epidemic, spreading through a house, and affecting almost every inmate.

Treatment.—The best results are obtained by sponging the inflamed parts freely with a strong solution of the nitrate of silver; and, if there be much constitutional depression, by administering full doses of ammonia, with camphor or bark. Should the disease go on to sloughing, constituting some one of the forms of "putrid sore throat" (which not unfrequently happens), the mineral acids and bark, with chlorinated port-wine gargles, and the brandy-and-egg mixture for support, will be found most useful. In many cases, this disease continues limited to the palate and fauces; but in others it extends either upwards or downwards. It may extend upwards through the nares, out of the nostrils, and thus spread over the face and head. It may extend downwards, affecting the gastro-intestinal membrane, or more frequently implicating the larynx.

Erysipelatous Laryngitis, as described by Ryland, Budd, and others, is an extremely dangerous affection. The inflammation in these cases, commencing in the fauces, rapidly spreads to the mucous membrane and loose submucous cellular tissue external to and within the larynx, giving rise to extensive oedematous infiltration of these parts with sero-plastic fluid, which, by obstructing the rima glottidis, may readily suffocate the patient. In consequence of this special tendency to oedema, the disease has by many writers been termed "*oedematous laryngitis*." After death, in these cases, the submucous cellular tissue of the fauces, that about the base and frena of the epiglottis, and especially that which covers the posterior part of the larynx, will be found to be distended with serum or a sero-puriform fluid. This infiltration occupies the rima of the glottis, and extending into the interior of the larynx, gives rise to such swelling that its cavity is nearly obliterated. Great as the swelling may be, however, in all these parts, it never spreads below the true vocal chords. This fact, which is of considerable importance, is owing to the mucous membrane coming closely into contact with, and being adherent to, the fibrous tissue of which these are composed, without the intervention of any submucous cellular tissue. The progress of this oedematous inflammation of the mucous membrane and loose submucous tissue in these situations, is often of an amazingly rapid character, the swelling being sufficient to induce suffocation at the end of thirty-six or forty-eight hours, or even sooner. If the patient be not carried off in this way, there will be a great tendency to suppuration and sloughing of the affected tissues, leading perhaps eventually to death from absorption of pus, and low constitutional fever.

The *symptoms* of this affection are strongly marked: the patient, after being attacked with erysipelas of the fauces, attended by some difficulty and pain in deglutition, with huskiness of the voice, is seized with more or less difficulty in breathing, coughs hoarsely and with a croupy sound, and complains of tenderness under the angles of the jaw and about the larynx. The difficulty in breathing increases, and may speedily threaten the life of the patient, giving rise to intense fits of dyspnoea, in one of which he will probably be suddenly carried off. On examining the throat from the interior of the mouth, the fauces will not only be observed to be much and dusky redness, but by depressing the tongue the epiglottis can be felt, and perhaps seen, to be rigid and erect.

In the *Treatment* of this affection, local means are of the first importance. The tongue having been well depressed, the posterior part of the larynx, the epiglottis, and its frena, must be well scarified by means of a hernia-knife, with which this operation may be most readily and safely done. The patient

should then be directed to inhale the steam of hot water, and a large number of leeches may be applied under each angle of the jaw, to be followed by large and hot poultices; at the same time, the bowels must be kept well opened, and the patient treated antiphlogistically or otherwise, according to the condition of the constitutional fever. Most frequently, in these cases, I have found antimonials of great service in the early stages, followed at a later period by support and stimulants. A few hours after the engorged tissues have been unloaded by scarification, the fauces, pharynx, and upper part of the larynx should be well sponged out with a strong solution of the nitrate of silver (ʒi. to ʒi.) which must be applied freely, coagulating the mucus, and taking down the increased vascular action. If, notwithstanding the employment of these means, the dyspnoea increase, the face becoming pale, livid, and bedewed with a clammy perspiration, it will be necessary, in order to save the patient from impending suffocation, to open the windpipe. In doing this I prefer the operation of laryngotomy, for reasons that will be mentioned when I come to speak of the diseases of and operations on the air-passages. In order that this operation should be successful, it must not, however, be too long delayed, and should not be looked upon as a last resource; if it be done in time (and time in these cases is most precious, owing to the rapid progress of the disease), the patient's life may probably be saved; but if it be deferred too long, congestion of the lungs will have come on, the blood will cease to be properly arterialed, and the patient will sink from a slow asphyxia, even though air be at last freely admitted. If the patient survive to the stage of sloughing, chlorinated gargles, bark, and support, must be our chief reliance.

ERYSIPELAS OF THE SEROUS MEMBRANES is of common occurrence in surgical practice, being frequently met with in the arachnoid and peritoneum. These, like all other serous membranes, are liable to two distinct forms of inflammation, one, which is of a sthenic character, having a tendency to the formation of plastic lymph; the other, which is of a diffuse or erysipelatous form, being always accompanied by the exudation of aplastic unorganisable fibrine.

Erysipelatous or Diffuse Arachnitis commonly occurs as a consequence of injuries of the head and erysipelas of the scalp. In these cases there is usually a flushed countenance, bright staring eyes, low muttering delirium, alternating with a comatose condition, and rapidly terminating in death; the constitutional symptoms are those of low irritative fever. On examination after death, the arachnoid and pia mater will be found greatly injected with blood, forming a close red net-work of vessels over the surface of the brain, the substance of which is usually somewhat injected, the ventricles being distended with a reddish coloured serum. If examined at a later period in the disease than this, the inflamed arachnoid will be found to be covered with a layer of opaque puriform lymph, of a greenish-yellow colour and slimy consistence.

Erysipelatous or Diffuse Peritonitis is not unfrequently met with in aged and cachectic subjects after the operation for hernia, or as a consequence of various diseases and injuries of the pelvic or abdominal organs. In this form of peritonitis, the symptoms are often of a latent character, the disease being chiefly indicated by obscure pain diffused over the abdomen with tenderness on pressure, and an anxious depressed countenance, a hot skin, and a small and rather hard pulse. On examination after death, the subperitoneal cellular tissue will be found injected, the peritoneum opaque in parts, covered with filmy patches of greyish lymph, and usually containing a largish quantity of opaque dirty-looking turbid fluid, mixed with shreds and flocculi of

lymph. This, though closely resembling pus in appearance, is serum with lymph intermixed, and is of a peculiarly acid, acrid, and irritating character. It is this form of peritonitis that is so dangerous to dissectors ; inoculations of the fingers with any of this fluid being often productive of the most serious and even fatal consequences.

Erysipelatous Inflammation of the Lining Membranes of the Vascular System will be fully discussed when we come to consider diseases of these parts.

CHAPTER XXXIII.

PURULENT INFECTION, OR PYÆMIA.

By *Pyæmia* is meant a dangerous and often fatal affection, supposed to depend upon the admixture of pus with the blood. This disease is closely allied in cause and in character to some of the lowest and worst forms of erysipelas and diffuse inflammation, with which indeed it is commonly associated, and to which it presents great similarity in its causes, symptoms, and effects.

CAUSES.—Like erysipelas, pyæmia commonly occurs at those seasons of the year, and under those atmospheric conditions, in which diseases of a low type are prevalent, frequently as the result of overcrowding in hospitals ; and it is in unhealthy and cachectic constitutions that it usually manifests itself. Though it is least frequently met with during the earlier periods of life, yet it may make its appearance at any age, and I have seen very young children carried off by it.

Pyæmia is a very common cause of death after operations and severe injuries, especially in hospitals that are situated in large towns or that are overcrowded. It is much disposed to by a scanty and unwholesome nourishment either before or after an operation. That pyæmia is the result of the faulty hygienic conditions just alluded to, viz., want of pure air, overcrowding, and insufficient and unwholesome diet, is evident from the fact of its being rife and most destructive where those causes of disease prevail, as amongst the poorer classes of all large and densely peopled towns ; while in the pure air of country districts, or in private practice amongst the wealthier classes, it is scarcely met with. It is one of those causes of death after operations that might and ought to be prevented ; and wherever it is frequent, we may be sure either that the constitutions of the patients are peculiarly deteriorated, or else that the hygienic conditions to which they are exposed after the injury or operation are faulty.

Pyæmia is never, I believe, an idiopathic or primary affection, but either occurs subsequently to an injury or wound of some kind by which inflammation is excited, which has in most cases reached the stage of suppuration before the pyæmic symptoms come on ; or it appears in connection with some low form of specific suppurative inflammation. Thus we often see boils, carbuncles, diffused abscess, erysipelas of the skin, or erysipelatous inflammation of the veins or absorbents, precede its occurrence. Pyæmia is especially apt to occur, if pus be confined deeply amongst the tissues and unable to get a ready outlet. Wounds of veins, of bones, and of joints, are the injuries that are especially apt to be followed by this disease ; and

in the puerperal state it is often met with, probably as the result of uterine phlebitis.

PHENOMENA.—Pyæmia is characterised specially by two series of phenomena: 1. A peculiar train of constitutional symptoms attended by a state of great depression of the powers of the system; 2. The formation of abscesses in various parts of the body.

1. *Symptoms.*—The patient is seized with rigors, usually very severe and continuous, but occasionally short and transient, sometimes occurring irregularly, at other times being repeated almost periodically twice or thrice in the twenty-four hours, for some days in succession. In some cases these rigors are not attended by any sensation of cold; but in others they are, and then alternating with much febrile disturbance, they resemble very closely an ague fit. Any open wound that may exist at this time usually becomes fenestrated, and ceases to secrete pus; but this is by no means necessarily the case, for I have seen it continue healthily granulating throughout the disease. The skin is usually hot, and has often a burning pungent feel. The breath has that peculiar sweetish, saccharine or fermentative smell that is commonly noticed in all febrile diseases of a low type; this odour of the breath, and indeed of the body generally, often occurs early in the disease, and must then be taken as a very unfavourable sign. The secretions are arrested; the pulse is quick and feeble; the face is usually pale, with a very anxious drawn look, but sometimes flushed, and the eyes bright, there are hebetude and dulness of mind, with slight nocturnal delirium, but perfect consciousness on being spoken to. Rapid wasting of the body sets in about this period; patches of erratic erysipelas frequently make their appearance on the surface; and the skin assumes a dull, sallow, and earthy, or a bright yellow icteric tint, which may extend even to the conjunctivæ. The symptoms now indicate an extreme depression of the vital powers, the pulse becoming small and fluttering, the tongue brown, often from the first with sordes about the teeth, and low delirium occurring. Usually from the sixth to the tenth day, but sometimes earlier, diffuse suppuration begins to take place in different tissues, joints, and organs. This may occur in the lungs or pleuræ without cough or pain; if seated in the cellular tissue, or in the substance of muscles, there is usually doughy swelling, with some redness; if in the joints, the swelling is often considerable, the pain usually intense and of a very superficial and cutaneous character, the patient screaming aloud with the agony he suffers. These pains, which are chiefly seated in the knees, ankles, hips, and shoulders, often simulate rheumatism very closely, and have not unfrequently been mistaken for that disease.

The progress of the disease is usually from bad to worse, sometimes rapidly but at other times not uninterruptedly so, there being remissions and apparent, though not real, improvement. The patient rapidly wastes, the body becoming shrunken, the muscles soft, and the skin grey or sallow, loose and pendulous; great debility also sets in. The abdomen becomes tympanitic, diarrhœa or profuse sweats come on; pneumonia or pleuritic effusions declare themselves; delirium, from which the patient is easily roused, alternates with sopor; and at last he sinks from exhaustion. Death usually takes place about the tenth or twelfth day, though it may occur as early as the fourth, or the patient may linger on for six or seven weeks.

In other cases pyæmia occurs in a very insidious manner, without rigors, but merely with prostration, and some low fever of an intermittent kind, after a time the skin assumes a yellow tint, as do the conjunctivæ. The urine is very high coloured, and perhaps the peculiar odour in the breath or body may be noticed; but the patient continues in a quiet state, his words

being clean, and suppurating healthily. He gets, however, symptoms of low pneumonia or pleurisy, perhaps with pain and fulness in one joint, where abscess forms, and then the disease fully declares itself.

2. *The Formation of numerous Purulent Deposits*, "secondary or metastatic abscesses," as they are often termed, is one of the most marked features of pyæmia. These abscesses usually contain a somewhat thin and only-looking pus; at other times, however, it is thick and laudable. The more only-looking fluid, though opaque and yellow, and closely resembling true pus, will, on microscopic examination, be found to differ from this in the absence of the true nucleated pus-corpuscles, though it contains an immense number of granular cells (Fig. 51). After removal it often forms a fine fibrinous coagulum. These purulent collections vary greatly in size and in situation. They are found in four localities, viz., in the viscera, in the cellular and muscular structures, in the serous membranes, and in the joints. They are most frequently met with in the lungs and pleura, usually in one pleural sac only; then in the joints; next in the intermuscular cellular planes.

Pyæmic abscesses differ from ordinary purulent collections, not only in the peculiar character of the pus that they contain, but more particularly in the rapidity with which they form, a few days commonly sufficing for them to attain a large size. So, also, their very widely spread character, and the insidious manner in which they occur, often with few if any local signs,—the tissues, as it were, breaking down without any inflammation,—constitute the distinguishing features of these collections.

The visceral abscesses vary in size from a pin's head to a walnut; in many cases the organs affected are studded with them. These collections are most frequently met with in the lungs, being seated at the posterior part and on the surface of these organs, or in the interlobular fissures; when occurring in the lungs, they are usually surrounded by a darkly inflamed and condensed layer of pulmonary tissue, and not unfrequently they are seated in the midst of a large patch of lung in a state of low or congestive pneumonia, or the whole of the posterior part of the lung may be in this condition studded with small pyæmic abscesses. The organ that is most frequently affected next to the lung is the liver. Here, also, the abscesses are usually small, numerous, and surrounded by an inflamed or congested areola of hepatic substance. In some cases, however, hepatic pyæmic abscess is single and of considerable size, perhaps as large as an orange. I have seen purulent collections in the spleen; but they are rare here, in comparison to the organs just named. They may occur in other organs; thus Mr. Gamgee has on several occasions observed them in the prostate.

When the pus is infiltrated into the cellular tissue and muscles of the limbs and trunk, it will form immense diffuse collections of a thin and serous matter, commonly mixed with shreds of the cellular membrane of the part, having no boundary of limiting fibrine. These collections are most frequently met with, perhaps, in the axilla, down the flank and about the back, in the iliac fossa, thigh or calf, and may either be confined to the subcutaneous, or extend to the deep intermuscular cellular planes in these regions; or they may even form in the muscular substance itself, being diffused between the fasciculi, which are softened and disintegrated. Most commonly the presence of these collections is indicated by patches of cutaneous or erratic erysipelas, and by a doughy, cedematous, and boggy state of the superjacent integuments.

Accumulations of pus and deposits of lowly organised lymph in and upon the serous and synovial membranes are very common in this disease; the pleura, the arachnoid, or the peritoneum may each be affected in this way.

In the pleura especially, these accumulations are frequent, and pyæmic empyema will often occur very suddenly with few, if any, general symptoms or local signs to indicate its presence. Frequently some of the joints, especially the knees and shoulders, become filled with a thin, yellow, purulent liquid. These arthritic abscesses are usually indicated by the occurrence of intense pain, often of a cutaneous or superficial character, with fluctuation and swelling in the articulation affected. It often happens, however, that large accumulations of pus form suddenly in joints, without having been preceded by pain or any other sign of mischief; in these cases the interior of the joint, though filled with pus, will be found to be tolerably healthy, there being no erosion of cartilage or destruction of ligament, but merely some inflammatory injection of the synovial membrane.

Not only are the appearances just mentioned commonly met with in cases of death from pyæmia, but we find the viscera, more particularly the brain and lungs, inflamed, and not unfrequently a diffused erysipelatous redness of some membranous surface, as of the arachnoid or the gastro-intestinal mucous membrane.

DIAGNOSIS.—The diagnosis of pyæmia is not always easy in the earlier stages, when the rigors, depression, and other signs of constitutional disturbance may be looked upon as common to other intercurrent diseases of a low type, more especially typhoid fever. From this, however, pyæmia may be distinguished by the frequent recurrence of long-continued rigors, and by the early supervention of brown and dry tongue, simultaneously with the shivering. As the affection declares itself, however, the continuance and severity of the rigors, the extreme want of power, the icteric tinge of the skin, the peculiar faint and sickly odour of the breath, and the occurrence of metastatic and visceral abscesses, indicate the true nature of the attack.

PATHOLOGY.—To what are the symptoms and destructive effects of pyæmia due? There can be little doubt that they are owing to the alterations that take place in the blood itself. It is only in this way that the remarkable diffusion of the disease, the variety of tissues affected, and the widespread tendency to suppuration that characterises it, can be explained. That the blood undergoes important changes in this disease is unquestionable: it is thin, dark-coloured, and, after having been drawn from the body, forms a loose spongy coagulum, from which a moderate quantity of rather turbid or milky-looking serum separates. On examination under the microscope it will be found that, besides the ordinary red corpuscles, the blood contains, often in large quantities, corpuscles that in some cases closely resemble the ordinary white ones of the healthy blood, and at others present such exact similitude to pus-cells, that the most practised eye fails in detecting a difference. These corpuscles may be few in number, and at other times so abundant that they occupy the field of the microscope to the exclusion of the red. The existence of these corpuscles in the blood, which I believe will invariably be found on careful examination, more especially in that taken from the larger veins, constitutes apparently one, if not the essential element of the disease. That they are true pus-corpuscles, in many cases, would seem to be probable from their microscopic appearances; in others, again, they do not present the characters of true pus-cells, differing from them in their shape, or in the absence of nuclei, and in their more irregular outline; resembling indeed more closely the white corpuscles, or some of the ill-developed granulation or exudation-cells that are met with in cold or lymphatic abscesses occurring in cachectic constitutions. Whatever differences of appearance these corpuscles may present, they can best be compared to those pus-cells that are found in

many unhealthy abscesses, and more especially in the diffuse purulent collections occurring in the cellular tissue or the joints in this very disease; and, like these, I think we must look upon them as products of inflammation, though perhaps of a low and aplastic form.

The questions that next present themselves are, how do these corpuscles find their way into the blood? and how do the other changes that occur in the physical characters of this fluid take place? To explain these conditions, many theories have been framed. By some surgeons it has been supposed that the pus is actually and bodily absorbed from the surface of the suppurating wound, and so admixed with the blood. This explanation, however, is not tenable, as there is not only no proof of, but no reason to believe in the possibility of, the absorption of a pus-corpuscle in its state of integrity from the surface of a wound. Then, again, it has been supposed that the pus having trickled, or in some other way found an entrance into the open mouth of a divided vein, as upon the surface of a stump or in a sawn bone, has gained access to the general circulation. But it is difficult to understand how pus can possibly become admixed with the general current of the blood in this way; for, if the vein be sufficiently open to allow of the entry of one fluid, it would certainly be so to admit of the escape of the other. The theory that has the most advocates at the present day is, that the pus enters the circulation as a consequence of phlebitis, being formed directly by the lining membrane of an inflamed vein, and thus poured at the moment of its evolution into the current of blood passing along the vessel. This dependence of pyæmia on suppurative phlebitis, more especially of a diffuse character, has been strongly advocated by Hunter, Arnott, Bernard, and others, and affords an easy solution to the difficulty; and it has acquired considerable weight from the fact that in many cases these affections are found co-existing. I am by no means prepared to deny that suppurative phlebitis and pyæmia stand in the relation of cause and effect in many cases, and that the pus does in all probability become directly admixed with the blood in this way. This explanation would indeed be conclusive, if it could be shown that phlebitis was the only, or even the most frequent, form of diffuse inflammation occurring in connection with pyæmia, and that it always took place as a precursor and concomitant of the blood-affection. But this I believe not to be the case. I have had opportunities of examining the bodies of a considerable number of patients who have died of pyæmia, and I have certainly often found evidence of other diffuse inflammations as well as of phlebitis; and in some cases no inflammation of the veins could be detected on the most careful investigation specially directed to this point; and hence I cannot but come to the conclusion that pyæmia, though frequently co-existing with suppurative phlebitis, may occur independently of it, and cannot therefore in all cases be necessarily considered a consequence of that disease.

On the other hand, Tessier has denied the dependence of pyæmia on suppurative phlebitis. He considers the pyæmia as an independent blood-disease, unconnected with the inflammation of the vein. This opinion is, however, so much at variance with the fact established by Hunter and Arnott, and since confirmed by most surgeons—that suppurative phlebitis is commonly followed by pyæmic symptoms—that it need not detain us.

Sedillot is of opinion that pyæmia is always preceded by a suppurative inflammation; that this is commonly of a phlebotic character; and that the symptoms are due to the admixture with the blood of pus, which can be detected and demonstrated in that fluid.

In the very excellent essay published by Mr Henry Lee on this subject, that surgeon expresses his opinion, that the introduction of pus into the

system from an inflamed or injured vein is rarely the first step in purulent infection, but must have been preceded by some change that has taken place in the blood, by which its coagulating power has been impaired. Mr. Lee's views are supported by a number of ingenious experiments.

My own views closely accord with those of Sédillot. I have never yet seen a case of pyæmia that was not preceded by a local inflammation, whether in the shape of an injury, or of some low form of idiopathic inflammation—often, but not necessarily, by suppurative phlebitis or lymphatis, and I believe that the constitutional symptoms are due to the deterioration of the blood by the admixture of puriform matter with it.

The explanation that I would suggest as to the cause of the presence of the true or imperfectly formed pus-cell in the blood in pyæmia is the following. For pyæmia to occur, I believe it to be invariably and absolutely necessary that a local inflammation previously exist in some part of the body. This may either be external or internal; it may be limited in area to that of a boil, or it may be as extensive as the surface of a sloughy stump. In all cases this inflammation is of, or tends to assume, a suppurative character; and in all the constitution is broken, and of that kind in which the corpuscular or aplastic lymph commonly forms. It is not difficult to suppose that the blood, in circulating through the part so diseased, instead of undergoing those peculiar changes that are impressed upon it in its passage through tissues that are strenuously inflamed, and of which the most remarkable is the formation in it of a large quantity of plastic filamentous fibrine,—as evidenced by the hard firm coagulum, by the formation of the bulky clot, and by the tendency to the deposition of coagulable lymph, as well as by the occurrence of constitutional fever of the æsthetic type,—may undergo alterations in composition of equal extent, though of a far different kind. It appears not improbable that the fibrine formed in the blood in these low inflammations, occurring in broken constitutions and at unhealthy seasons, may assume that corpuscular or aplastic character which we have already seen to be the invariable result of these conditions; and that the corpuscles, which are met with intermixed in greater or lesser quantity with the blood in pyæmia, and which bear a sufficiently close resemblance to granulation or exudation-cells, to all the various forms of the unhealthy pus-corpuscle, and occasionally to its typical variety, in reality represent the conditions under which superfibrination of the blood with corpuscular lymph would necessarily show itself. Consequently, instead of being formed from without, and absorbed or poured into the blood, the corpuscles are actually generated in that fluid itself during its passage through the unhealthy inflamed tissue—not, however, by any conversion of the blood-corpuscles into lymph or pus-cells—as a consequence of those changes which we know, by their effects, to be impressed upon the blood by circulation through inflamed tissues, but with the precise nature of which we are still unacquainted. It is also by these blood-changes in pyæmia that we may account for the remarkable constitutional depression that exists; for if, as there is every reason to believe, the admixture of plastic fibrine with the blood will occasion æsthetic inflammatory fever, the formation of aplastic exudation-matter in that fluid may occasion a corresponding low type of constitutional disturbance.

As the blood circulates through an inflamed vein, not only would these changes take place in it that occur in its passage through other tissues, but it would thus become mechanically mixed with the pus and exudation-matters poured out in large quantity by the lining membrane of the vessel, and hence we may explain the greater liability to the occurrence of pyæmia

after, or in combination with, suppurative phlebitis, than in connection with any other inflammatory affection elsewhere situated.

When once these corpuscles are admixed with the blood, it is probable that abscess is a necessary result from their mechanically occluding the capillaries, as Cruveilhier long ago showed experimentally to be the case. The pus-cells, being larger than the blood-corpuscles, become arrested in the capillaries of organs, and thus constitute points of irritation, around which inflammation is set up, and in which suppurative action takes place; these changes being first induced in those organs the capillaries of which are of a very small calibre, as in the lungs.

The tendency to suppuration of joints and to the formation of diffused collections in the muscles and cellular tissue can scarcely, however, be accounted for in this way; and is probably dependent on other causes, amongst which the low crisis of the blood is the most powerful.

TREATMENT.—The treatment of pyæmia is of the most unsatisfactory character. It doubtless happens that patients occasionally recover from this disease, even after the formation of diffuse abscesses; but such a result must be looked upon as a happy exception to its commonly fatal termination. The only plan of treatment that holds out any reasonable hope of success, appears to me to be the stimulating and tonic one, consisting of brandy or wine, ammonia, bark, and beef-tea; in fact, that plan of treatment which is usually adopted in low inflammations. I have certainly seen service done in some cases, and indeed recovery effected, by the administration of large doses of quinine; as much as five grains being given every third or fourth hour, with the best effect. A very serious case of pyæmia, under my care at the hospital, occurring after amputation of the arm, and accompanied not only by all the symptoms of that disease in a very marked manner, but by pleuritic effusion, swelling and tenderness over one hip, and secondary hæmorrhage from the stump, was cured by perseverance in the tonic and stimulating plan of treatment. In some cases I have administered the chlorate of potash largely (3 \mathfrak{ij} in the day), in addition to the quinine and wine, with apparent benefit. If the depression be very great, carbonate of ammonia in ten or fifteen grain doses may be given from time to time; such nourishment as the patient will take, with a liberal allowance of wine, portier, or brandy, being also administered. In addition to this curative treatment, hygienic measures must be put in force. The patient should be placed in an airy and well-ventilated apartment, and cleanliness carefully attended to.

In the case of a superficial vein being inflamed, it has been recommended by some of the French surgeons, as Bonnet, Bérard, and Langier, that the actual cautery should be freely applied along the course of the vessel, and they state that the best results have followed this practice. As abscesses form, they must be freely opened; and the diffuse and purulent collections forming in the cellular tissue must be evacuated.

CHAPTER XXXIV.

TUMOURS.*

THE frequency with which tumours fall under the observation of the surgeon, the great variety in their characters, and their important relations, local as well as constitutional, render their consideration one of great moment. According to Hunter, a tumour is "a circumscribed substance produced by disease, and different in its nature and consistence from the surrounding parts." This definition, though not perhaps accurately correct in some forms of tumour, which do not differ in their nature from neighbouring parts, is yet substantially a good and convenient one. By a tumour may also be said to be meant a more or less circumscribed mass, growing in some tissue or organ of the body, and dependent on a morbid excess of, or deviation from, the nutrition of the part. The tumour thus formed increases in size by an inherent force of its own, irrespectively of the growth of the rest of the system, and differs essentially from the normal structure and appearance of the part of the body in which it grows. In order to constitute a tumour, it is necessary that the normal form of the part be widely departed from; a mere increase in its size, so long as it preserves its usual shape, being scarcely considered in this light. Thus if the tibia be uniformly enlarged to double its natural size, the enlargement is a hypertrophy, not a tumour; but, if a comparatively small rounded mass of bone project directly forwards from its tuberosity, it is said to be a tumour, and not a mere hypertrophy.

CLASSIFICATION OF TUMOURS.—Surgeons divide tumours into two great classes, the *Non-Malignant* and the *Malignant*. This division, though practically convenient, is not scientifically exact. Recent researches have shown that although some tumours, as the cancers, are always and essentially malignant, and others as uniformly benign, as lipomas and some cysts; yet many others that are usually innocent may, under certain conditions at present unknown, take on a truly malignant action; this has led to the establishment of an intermediate group that may be termed the *Semi-Malignant*.

The *Non-Malignant*, *Innocent*, or *Benign Tumours* are strictly local. They resemble more or less completely the normal textures of a part, and hence are very commonly, though not perhaps with strict propriety, termed *homomorphous*. They usually, though not invariably, grow slowly, are more or less distinctly circumscribed, being often enclosed in a cyst, and have no tendency to involve neighbouring structures in their own growth, any change that they induce in contiguous parts not consisting in the degeneration or conversion of these into their own structures, but simply in displacement or atrophy by their size and pressure. They are sometimes single, but not unfrequently multiple, developing either simultaneously or successively; but if in the latter mode, without any connection with preceding growths. If removed by operation, they do not return; but, if left to the natural processes of nature, they may slowly attain a great size, remain stationary, and at last atrophy, decay, or necrose.

The essentially *Malignant Tumours* differ widely from those last described.

* In Paget's *Lectures on Surgical Pathology*, will be found the most philosophical account of Tumours in this or in any other language.

They cannot be considered as strictly local diseases, as in many cases they result primarily from a constitutional vice, or, if local in the first instance, have a tendency rapidly to affect the constitution. They are essentially characterised by an extreme vegetative luxuriance and an exuberant vitality. They proceed from a germ which, in a manner at present unknown to us, is formed in some organ or tissue, where it develops by an inherent force of its own, irrespectively of neighbouring parts, producing a mass which differs entirely in structure and appearance from anything observed in the normal condition of the body, and hence, is not unfrequently called *heteromorphous*. This term, however, cannot be considered strictly accurate; inasmuch as the microscopic elements of which this mass is composed have their several analogues in the normal structures of the body. This mass, which may either be infiltrated in the tissues, or localised by being confined to a cyst, increases quickly in size; not uncommonly, indeed, the rapidity of the growth may be taken as a measure of the malignancy of the tumour. As it increases in size it tends to implicate the neighbouring structures in its own growth, and to affect distant organs through the medium of the lymphatics or the blood; if removed by operation it has a great tendency, under certain conditions, local and constitutional, to return in its original site or elsewhere, though it does not necessarily do so. If left to its own development, a malignant tumour will inevitably soften, necrose, and ulcerate, often with much pain, profuse hemorrhage, and the induction of a peculiar state of constitutional cachexy, which speedily and necessarily terminates in death.

The malignant tumours are usually of a cancerous nature, but "*malignant*" and "*cancerous*" are not synonymous. Every malignant tumour is not a cancer, though every cancer is a malignant growth. Some tumours are malignant in their course, though they present neither to the naked eye nor to the microscope any cancer-structure or any heteromorphous constituent, but are strictly homomorphous, being fibrous, fibro-plastic, or cartilaginous. In most instances such tumours are benign in their course as well as in their structure, but in other cases, and without any evident cause, they affect a truly malignant action; thus the term "*malignant*" would have reference rather to the course adopted by the tumour than to the structure of the growth itself, for a tumour may be anatomically benign, but functionally malignant. Paget has very fully described varieties of the fibro-plastic as well as of the fibrous and cartilaginous tumour, which, though preserving throughout an uniform character, microscopical and otherwise, which is not considered malignant, have nevertheless destroyed the patient by repeated recurrence after removal, and by ultimate ulceration, sloughing, and contamination of neighbouring tissues, or even of distant organs through the medium of the circulation. He makes the important observation that, in different persons and under different conditions, the same disease may pursue very opposite courses, appearing in some to be of an innocent, in others of a malignant type; and he makes the very interesting practical remark, which agrees entirely with the result of my own observation, that the children of cancerous parents may be the subject of tumours apparently innocent in structure, but certainly resembling malignant growths in the rapidity of their progress, their liability to ulcerate and to bleed, and their great disposition to return after removal.

Interposed between these classes, we find a third group, partaking more or less of the characters of both, these may be termed *Semi-Malignant Tumours*.

Innocent and malignant tumours are occasionally met with in the same

person, four or five different kinds of growth even occurring in one individual. I have seen in one patient a scirrhus breast, an enchondromatous tumour of the leg, and an atheromatous cyst on the back, with sebaceous glands in the neck. Malignant and benign formations may even be found in the same mass; thus encephaloid and enchondroma are not unfrequently met with together in the testis. This, however, must not be taken as any evidence of the possibility of the conversion of one into the other, and indeed there is no proof that a non-malignant can be converted under any circumstances into a malignant tumour of a different type; a fibrous growth may degenerate and assume all the character of malignancy, at last destroying the patient, but there is no evidence that it can ever be changed into a cancerous mass. A malignant tumour may, however, be deposited on the site of a non-malignant growth that has been removed: thus I have seen a scirrhus nodule deposited in the cicatrix left after the removal of a cystic sarcoma of the breast.

Besides these various forms of tumours, others are met with of a constitutional and specific character, such as those that occur in connection with scrofula and syphilis.

NON-MALIGNANT AND SEMI-MALIGNANT TUMOURS.

These tumours may be most conveniently arranged in three great classes.

I. Encysted Tumours of all kinds.

II. Tumours dependent on the Simple Increase of Size of already existing Structures, in the tissues or organs in which they occur; as, for instance, fatty tumour in adipose tissues, exostosis in connection with bone, &c.

III. Tumours dependent on the New Growth of already existing Structures in situations where they are *not* normally found; as, for instance, a cartilaginous tumour in the midst of cellular tissue, or a fibrous tumour under a serous membrane. It is in this class that the semi-malignant growths are found.

I. ENCYSTED TUMOURS arrange themselves into two great classes. 1. Those that are dependent upon the Gradual Accumulation of a Secretion in a naturally existing Duct or Cyst, with dilatation and hypertrophy of its walls: 2. Those that result from the New Formation of a Closed Cyst in the cellular tissue of the part, and the distension of it by the secretion from its lining membrane.

1. *Encysted Tumours, arising from Simple Distension and Gradual Hypertrophy of the Walls of a Duct or Cyst*, are met with in three forms. (a) Encysted tumours of the skin and subjacent cellular tissue occurring in various parts of the body, and dependent on the closure of the excretory ducts of the sebaceous glands: (b) Tumours formed by the accumulations of secretions in, and the closure and dilatation of, the ducts of other secreting glands and organs, as in the sublingual or the mammary gland: (c) Those formed by the retention and modification of the secretions in cysts without excretory ducts, as in the bursæ.

(a) *Encysted Tumours, occurring from the Obstruction of the Excretory Ducts of the Sebaceous Glands*, include the various forms of *Atheromatous Tumours* that are met with on the surface of the body. These are usually situated upon the scalp, face, neck, or back; sometimes, however, they occur elsewhere—thus I have removed a very large one from the fore part of a girl's arm, and others from the labia and groin. The site of these tumours varies from that of a pin's head to an orange; the smallest occur on the eyelids, the largest on the shoulders and scalp. They are often very numerous, especially about the head, where as many as thirty or forty may

be met with at the same time ; and most frequently they form in women about the middle period of life : they are smooth, round, or oval, moveable under the integument, either semi-fluctuating or elastic, though sometimes solid to the touch. In some parts where the sebaceous follicles are large, as on the back, a small black point can often be detected on the surface of the tumour, through which an aperture may be found leading into its interior, and allowing the expulsion of its contents. In structure they are composed of a cyst which varies greatly in thickness, being sometimes thin, filamentous, and soft ; in other cases so thick, hard, laminated, and elastic, that it is almost impossible not to believe it to be a new formation ; these cysts attain their greatest density on the scalp, and are here often very firm, elastic, and resisting, even though of but small size. In structure they are composed of cellulo-fibrous tissue, with an epithelial lining, and generally appear to consist of dilated and hypertrophied sebaceous follicles ; though not improbably, as Paget supposes, they may at times be new formations. They are usually attached by loose cellular tissue to the subjacent parts ; but, if thin, they are often pretty closely incorporated with the superimposed skin ; if inflammation be set up around them, they become more solidly fixed. The contents of these cysts are very various, most usually consisting of a soft, creamy, pulaceous, or cheesy-looking mass, of yellowish white colour, which has sometimes in old cysts become dry and laminated, looking not unlike parmesan. In others, of old standing and large size, the contents may be semi-fluid, the more liquid parts being of a brown, green, or blackish tint. These various contents are essentially composed of sebaceous secretion, mixed in various proportions with epithelial scales, fat-granules, cholesteroline, granular matter, and rudimentary hairs (Fig. 156).

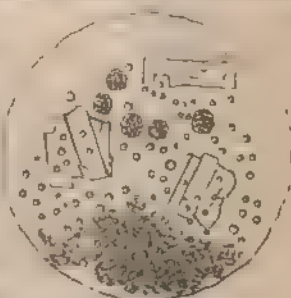


Fig. 156.—Contents of Sebaceous Tumour.

Progress.—The growth of these tumours is often very slow ; but not unfrequently, after remaining stationary for years, they take on a rather rapid increase. The tumour itself, though painless, may give rise to uneasy sensations, by compressing nerves in its vicinity : it usually continues to grow slowly, until the patient, being annoyed by its presence, has it removed by operation. If left untouched, it occasionally, though rarely, happens that the sebaceous matter, extruding through an aperture on its surface, forms a kind of scab or crust, which by a process of subdeposition becomes conical ; and, being gradually pushed up from below, at the same time that it assumes by exposure a dark brown colour, forms an excrescence that looks like a horn, and is usually considered to be of that character (Fig. 157). These “horns” have been met with on the head, on the buttock, and in other situations. The accompanying drawing is taken from a child four years old, brought to me to have its horn removed ; a woman also once applied to me with one about an inch and a half long, growing from the upper lip.



Fig. 157.—Horn on Nose of a Child.

In other cases, these tumours inflame and suppurate ; the skin covering them becomes adherent and reddened, ulceration takes place, and, if the

cyst be small and dense, it may be thrown off by the suppurative action in the surrounding tissues. If it be of larger size, ulceration of the integuments covering it takes place, and the sebaceous matter is exposed; this may then putrefy, become offensive, and break away in unhealthy suppuration. In other cases, again, peculiar changes take place in this tissue: large granulations are thrown out in it, and the atheromatous mass appears to vascularise, becoming irregular and nodulated, rising up in tumour-like growths with everted edges, exuding a fetid, foul discharge, becoming adherent to subjacent parts, and assuming a very malignant appearance, forming at last a sore perhaps as large as a saucer, as in the annexed figure of a case sent to me by Dr Bryant (Fig. 158). Sebaceous cysts which have undergone this change, may, however, readily be distinguished from malignant



Fig. 158.—Ulcerated Encysted Tumour of Scalp.

growths by a microscopical examination of their exudations or debris; these consisting of pus and healthy epithelium, mixed up with fatty matters more or less disintegrated.

Diagnosis.—The only diseases with which these tumours can be confounded are abscesses and fatty growths. From an abscess an encysted sebaceous tumour may be distinguished by its history, slow growth, situation, elasticity, and mobility, and the existence of the dilated orifice of the sebaceous duct, through which some of the contents can be squeezed, the microscopical examination of which will serve to confirm the diagnosis. From fatty tumours these growths may be diagnosed by their firmer and more regular feel: and in case of doubt by the evacuation and examination of their contents.

The *Treatment* of a tumour of this kind simply consists in its removal, after which it is never reproduced. This may most readily be done by transfixing and cutting it across with the scalpel or bistoury, and then, seizing the side of its cut edge with a pair of forceps, pulling the cyst out of its loose cellular bed. This plan may commonly be adopted with tumours seated about the head, face, or neck. When seated about the back, trunk, or limbs, they usually require to be dissected out, being more closely incorporated with the skin, and often, in consequence of former inflammation, adherent to the subjacent parts. In doing this, care should be taken that the whole of the cyst is extirpated; the wound should be dressed lightly, and speedily heals. If, however, any portion of the cyst be left, a troublesome fistula may remain. When they occur upon the scalp, a large number of these tumours may be removed at one sitting; as, however, there is always some danger of erysipelas following operations in this situation, it is only prudent to select a favourable season of the year, and not to operate if the tumour be in any way irritated at the time, or the health out of order. Erysipelas is especially apt to occur after these operations in elderly people of a stout make and florid complexion. When the tumours are situated between the shoulders or on the back, and the patient is unwilling to submit to an operation, I have easily and successfully got rid of them by opening up with a probe the small black orifice, which will always be found leading into them, squeezing out the contents of the cyst, and then pushing in

two or three silk threads, which, acting like a seton, have excited the requisite amount of inflammatory action to bring about a closure of the cyst.

The horns and semi-malignant ulcers that result from these growths, may require excision. If, however, the ulceration be connected with the cranium by its base, or be very extensive, as in the case depicted (Fig. 158), it will be safer to treat it by the application of a weak solution of the chloride of zinc, or by occasionally touching it with fused potash.

(b) Various forms of encysted tumour may arise from the *Closure and Inflation of the Ducts of other Excretory Organs*; as, for instance, *ranula* from the occlusion of the salivary ducts, *encysted hydrocele* from the closure of the tubuli testis, or *cystic tumours of the breast* from the obstruction of the lacteal ducts. These affections, however, constitute special diseases, the consideration of which must be deferred to subsequent chapters. The general principle of *Treatment* in these kinds of affection, consists either in restoring the freedom of the outlet by the excision of a portion of the wall, or obliterating the cyst by making an incision into it, and allowing it to granulate from the bottom.

(c) Cysts may arise from the *Distension of Cavities which are Unprovided with any Excretory Duct*; as, for instance, the *bursæ*; which often attain a very considerable size under these circumstances. The structure of these cysts becomes greatly altered; sometimes the walls are thin and expanded; at others they acquire a thick cellulo-fibrous, almost ligamentous, appearance. Inside they are often warty-looking, from the deposition of imperfectly organised fibrine, often arranged in a laminated form. Not unfrequently attached to the walls, and floating in the interior, are a number of granular, *melon-seed-like* bodies, greyish or yellow in colour, semi-transparent, elongated or irregular in shape, usually rather hard, but at others soft and flocculent. These appear to be composed of masses of imperfectly organised fibrine, somewhat resembling in structure granulation-cells, and often form in large quantities, so as to block up the interior of the cyst, converting it into a solid tumour. The fluid contents of these cysts are usually thin and serous, of a yellowish or brownish colour. In their progress these cysts are found to increase up to a certain size, when they usually thicken and harden, in consequence of the fibrous transformation just described; or else they inflame and suppurate in an unhealthy manner. They may occur in any of the situations in which bursæ naturally exist or are accidentally formed, and which will be mentioned hereafter, but are most commonly met with upon the knee-cap, the nates, or the first joint of the great toe.

The *Treatment* of these cysts consists in attempting their absorption by the use of stimulating plasters; or, if this fail, in the removal of their contents by tapping. Their cavities are then closed by exciting inflammation and suppuration within them, by the introduction of a seton, by injection with stimulating solutions, or by the subcutaneous section. If these means fail, *excision* will be required, more especially if the tumour have assumed a dense and fibrous character.

2. Cysts occasionally are met with as *New Formations*, filling by their own secretion. They occur in the general cellular tissue, and in connection with the sheaths of tendons; but most frequently about the generative organs, more especially in the ovary, in the broad ligament of the uterus, or in the breast. These cysts vary most widely in size, from that of a millet-seed to tumours weighing many pounds, and filling up the greater part of the abdominal cavity. When small, they are usually thin-walled, and are often invested in a matrix composed of imperfect hypertrophy of the organ in which they are situated, as in the breast and testes; when large, as in the

ovary, the walls are thick, firm, satiny, and often very tough. Projecting into their interior are solid masses, consisting of cauliflower like growths, occasionally filling up the whole inside of the cyst with compact solid white layers. These "intracystic" growths cause by their increase in size the gradual absorption of the more fluid contents, until, at last, their development is arrested by the cyst-wall.

These cysts may be divided into the *simple* and the *compound*. The *Simple*, or, as they are commonly called, *Serous Cysts*, are met with in almost every situation, being composed of a thin expanded wall, containing a slightly viscid serous fluid.

The *Compound*, or, as they are often called, *Proliferous* or *Multilocular Cysts*, are especially met with in the ovary, and have been studied with great care by Hodgkin. Of these there are two varieties, the first consisting of an aggregation of simple cysts closely packed and pressed together; the second composed of cysts having others growing from their walls. The cavities of these multilocular cysts present the greatest possible variety in their contents; fluid, from a limpid serum to a semi-solid jelly-like matter, and of every shade, from light-yellow to greenish-black, or dark-brown, is met with in them: solid intracystic growths, cancerous masses, or the *divers* of epithelial and cutaneous structures, are also found in them.

Encysted Tumours containing Hair and Fatty Matters (Pilo-cystic Tumours), are occasionally met with. These would, in many instances, appear to be the remains of blighted ova inclosed in the body, as they are congenital and usually contain some foetal *débris*, such as portions of bone, teeth, &c. The hairs in these tumours are connected with, and grow from, cuticular structures in which sebaceous follicles are commonly distinctly observable. The fatty matter which they contain in large quantity, and which may either be solid or perfectly fluid, is in all probability the result of fatty degeneration of the soft tissues of which they are composed. These tumours are most frequently met with in the abdomen, especially about the ovaries, mesentery, and omentum: they have also been observed in connection with the testis, having probably descended into the scrotum with this gland. A very remarkable case of this kind once occurred at University College Hospital under Mr. Marshall. They have also been found about the face, within the skull, and in the lung, but never, I believe, in connection with the extremities.

The *Sanguineous Cyst*, or *Hæmatoma*, is a peculiar variety of the simple form, and has been described by Paget as principally occurring about the neck, the parotid, the anterior part of the thigh, the leg, the shoulder, and the pubes. It is especially characterised by containing fluid blood, more or less altered in appearance. He describes these cysts as being formed in three possible ways; either by hemorrhage into a previously existing serous cyst, by transformation from a *nævus*, or by a vein becoming occluded and dilating into a cyst. These sanguineous cysts may sometimes resemble in general appearance encephaloid disease. A case of this kind was sent to me by my friend Dr. Henry Bennet—a tumour of about the size of an orange, of nodulated appearance, existing in the leg of a woman below the knee, where it had been gradually increasing in size for about a couple of years. So close was the resemblance to malignant disease presented by the tumour, that the limb had been condemned for amputation by some surgeons who had previously seen the case; as, however, the growth, on examination, proved to be a sanguineous cyst, as its walls were thin and adherent, and as it extended too deeply into the ham to admit of ready removal, I reduced it by successive tappings, and then, laying it open, allowed it to granulate.

from the bottom. When practicable, however, the cyst should always be dissected out.

II. TUMOURS ARISING FROM SIMPLE INCREASE OF SIZE OF ALREADY EXISTING TISSUES.—These tumours differ from simple hypertrophy of the part "in this, that to whatever extent the hypertrophy may proceed, the overgrown part maintains itself in the normal type of shape and structure, while a tumour is essentially a deviation from the normal type of the body in which it grows." (Paget.)

This section comprises, 1. Tumours connected with the Integumental Structures, as Warts, Polypi, &c.; 2. Lobular Hypertrophies, with more or less Modification of Glandular Structure, as in the breast; 3. Fatty Tumours; 4. Fibro-cellular Tumours; 5. Vascular Tumours; 6. Tumours of Nerves; and 7. Tumours of Bones.

1 Simple Tumours developed on the Integumental Structures, whether Cutaneous or Mucous.—Warts and Condylomata essentially consist in an increased deposit of laminated cuticle, usually with some augmented vascularity of the cutis. They exist with especial frequency in the mucous, the muco-cutaneous, and the more perspirable surfaces; thus the prepuce, the vagina, the axilla, and the cleft of the nates are their chosen seats. When occurring on the skin, they are usually hard and horny where the cuticle is naturally dry, and then constitute true warts; but where the skin is perspirable, and the cuticle moist, they are flattened, expanded, soft, and white, and are then termed condylomata or mucous tubercles. When situated on the mucous membranes, they are usually pointed, somewhat pendulous, or nodulated on the surface, very vascular, and bleed readily when touched.

Closely allied to some of these warty structures is a peculiar pinkish-white fibro-vascular tissue, which is occasionally met with in old cicatrices, more especially after burns, as an outgrowth of these, and not unfrequently occurs after removal; this disease is termed *Cheloid*.

The general principles of *Treatment* of these affections consist in their removal by excision, ligature, or caustics, according to their size, situation, and attachments. Excision is usually preferable when they are seated on mucous surfaces; the ligature should be used if they be large and pendulous; and caustics should be employed when they are seated on the skin or on a muco-cutaneous surface.

Pendulous Sarcomatous Growths, forming large tumours commonly called *Wens*, may occur on any part of the surface. They are smooth, pedunculated, firm, somewhat doughy, but non elastic, pendulous, and moveable, slowly increasing without pain, often to a very great size. It is in warm climates, and in the Hindoo and Negro races, that they attain their greatest development, having been met with fifty, seventy, and even a hundred pounds in weight. They are chiefly seated about the genital organs, enveloping the scrotum, penis, and testes in the male, or depending from the labia of the female. That remarkable enlargement of the leg occurring in the Mauritius, and some parts of the West Indies, and hence termed *Barbales leg*, is an affection of this kind. In structure these growths appear to be a simple hypertrophy of the fibro-cellular element of the part affected, being composed of a loose reddish stroma, moist with a serous fluid. In the *Treatment* of these affections, pressure and iodine applications may be tried in the earlier stages, with the view, if possible, of checking their growth; at a later period they must, if large, be removed by operation, though this procedure is at times an extremely severe one, owing to the great magnitude they attain.

Polypi are pendulous masses growing from any mucous surface, but more

especially from the nose, ear, throat, uterus, and rectum. The term *polypus* is applied very indiscriminately to various pendulous tumours growing from mucous membranes. The true *mucous* or *gelatinous* polypus is composed of the elements of mucous membrane expanded and spread out, and consists of a loose fibrous stroma covered by epithelium more or less distinctly ciliated, the cilia being often beautifully seen when recent specimens are examined under the microscope. The so-called *fibrous* or *medullary* polypus consists of other forms of tumour growing from, and covered by, mucous membrane. The true mucous polypus grows rapidly, being a soft and vascular reddish-purple or brown-looking mass, and may expand greatly, giving rise to serious symptoms of obstruction in the passage in which it is situated, bleeding freely when touched, destroying the bones by its pressure, and producing great mischief and disfigurement. It is especially in the nose and the uterus that it attains to a large and dangerous size. The *Treatment* consists in removing it according to its situation, its degree of vascularity, and the nature of its attachment, by avulsion, ligature, or excision.

2. *Hypertrophy of Glandular Structures*.—This forms an important series of special affections, chiefly occurring in the lymphatic glands, the breast, and the testes. The part becomes chronically enlarged and indurated, often without any signs of inflammatory action, though in other cases as the result of this condition. On examination, the structure of the gland will either be found to have undergone an imperfect and ill-developed hypertrophy in some of its lobules, or to be expanded and infiltrated with plastic matter, the consequences of chronic inflammation; or to have undergone intercellular deposition when the hypertrophy occurs in strumous subjects. The *Treatment* in these tumours consists in an endeavour to remove the mass by friction with the preparations of iodine, or by the application of stimulating and absorbent plasters. If these means fail, methodical pressure may sometimes advantageously be employed; and, as a last resource, extirpation by the knife must be performed.

3. *Fatty Tumours* constitute an important class of surgical diseases, as they occur very extensively in almost every part of the body, and at all ages, though they are most commonly met with about the earlier periods of middle life. In the majority of cases they appear to originate without any evident cause; in other instances again they can be distinctly traced to pressure or to some local irritation, as to that of braces or shoulder-straps over the back and shoulders. In one case I have known the disease to be hereditarily transmitted to the members of three generations of a family.

Fatty accumulations take place under two forms, one diffused, the other circumscribed; it is the latter variety only that is termed the *Adipose Tumour*. The diffused form of fatty deposition occurs in masses about the chin or nape without constituting a disease, though it may occasion much disfigurement.

Fatty or *Adipose Tumours* may form in all parts of the body as soft, indolent, inelastic, and doughy swellings, growing but very slowly, being either oval or round, but not unfrequently lobulated, and occurring most frequently in the subcutaneous fat about the neck and shoulders, but occasionally met with between the muscles, in the neighbourhood of joints, of serous membranes, as of the pleura, and of mucous canals. A very curious circumstance connected with these tumours is that they occasionally shift their seat, slowly gliding for some distance from the original spot on which they grew; thus, Paget relates cases in which fatty tumours shifted their position from the groin to the perineum or the thigh. I have known one to descend from the shoulder to the breast.

They may attain a large size, but only occasion inconvenience by their

pressure or bulk, they rarely ulcerate or inflame, nor do they undergo any ulterior changes of structure.

These fatty growths have been divided into three varieties, according to their structural differences. The most common form of fatty tumour, that called *Lipoma*, is a mass of yellow oily fatty matter and cellular tissue, enclosed in a fine thin capsule, having small vessels ramifying over its surface. This tumour is usually more or less lobulated, often remarkably dentated, and sending out irregular prolongations that extend to some little distance into the surrounding cellulo-adipose tissue. Another variety, the *Cholesteatoma* of Muller, is of much less frequent occurrence, it is a smooth, laminated, white and dry fatty mass, contained in a cyst, and apparently composed of crystalline fat enclosed in meshes of cellular tissue. The third variety of fatty tumour consists of soft semi-diffusent masses occurring in the ovary, or in multilocular cysts in other situations.

In the *Treatment* of fatty tumours little can be done except by extirpation with the knife, by which the patient is speedily and effectually rid of the disease. The tumour, being encapsuled, and but loosely adherent to adjacent parts, readily turns out, and the wound often heals by the first intention. It is true that we have the sanction of Sir B. Brodie's high authority for the administration of the liquor potassæ in some of these cases, under which treatment this eminent surgeon states that fatty tumours have occasionally disappeared.

4. *Fibro-cellular Tumours*, described cursorily by many writers as *cellular* tumours, have been more fully examined by Paget. They are not of common occurrence; and when met with they are most frequently found in the scrotum, the labium, the deep muscular interspaces of the thigh, and on the scalp, in which situations they may form large masses, attaining sometimes to a weight of many pounds. The accompanying Figure (159) is taken from a tumour of this kind, which I removed from the side of a woman. When they occur about the scrotum and labium, these tumours must not be confounded with elephantiasis of these parts, from which they may be distinguished by being limited and circumscribed masses, and not more outgrowths. They happen only in adults who otherwise are in good health, and grow quickly, forming soft, elastic, rounded, and smooth tumours, they are not attended by any pain. After removal they are found to possess a thin capsule, to be of a yellowish colour, and to contain a large quantity of infiltrated sero-plastic fluid, which may be squeezed out abundantly, and coagulates on standing. As these tumours are perfectly innocent, no hesitation need be entertained about their removal.



Fig 159 -Fibro-cellular Tumour

5. Tumours dependent on an increase of the *Vascular Tissue*, as aneurism by anastomosis, of the *Nervous Tissue*, as some kinds of neuroma; and of *Osseous Tissue*, as exostoses; and never extending beyond the structure primarily implicated, constitute such especial affections, that it will be more convenient to reserve their consideration until we come to speak of the particular diseases of the structures to which they belong; and it will be sufficient for the present to indicate their existence as pertaining to this group.

III. TUMOURS DEPENDING ON THE NEW GROWTH OF STRUCTURES IDENTICAL WITH, OR VERY CLOSELY RESEMBLING, NORMAL TISSUES IN SITUATIONS WHERE THEY ARE NOT NORMALLY FOUND.—This class is an important one inasmuch as it contains not only innocent growths, but some that are of a semi-malignant character. The fibrous, the fibro-plastic, and the ecchymatous tumours are those that are chiefly met with in it.

1. *Fibrous Tumours*.—These growths are by no means so common as many of the affections that have already been described; they are met with in various situations, as in the testes and mamma, uterus and antrum, about joints, in the periosteum, in the subcutaneous cellular tissue, and in connection with nerves. The situations in which they are most frequent, and where their structure is most typical, is in the neck, especially in the parotid region, in the uterus, and the antrum. In shape these tumours are irregularly oval or rounded; they are smooth, painless, and moveable; they grow slowly, but may attain an enormous size, equal to that of a cocoon cut or water-melon. Liston removed from the neck one, which is at present in the Museum of the College of Surgeons, that weighed twelve pounds. They have, however, been found weighing as much as seventy pounds. They are almost invariably single, and when cut into present a white glistening



Fig. 160.—Structure of Fibrous Tumour

fibrous structure, being composed of uncoloured fibres like those of ligamentous tissue (Fig. 160). These tumours may remain stationary for years, and this is the condition in which they are often presented to the surgeon. Eventually, however, they are apt to undergo disintegration, becoming infiltrated, cedematous, and softening in the centre, or at various parts of the circumference, they then break down into a semi-fluid mass, the integuments covering them inflame and slough, and an unhealthy pus, mixed with disorganised portions of the tumour, is poured out, leaving a

large and unhealthy sloughy chasin, from which fungous sprouts may shoot up, readily bleeding on the slightest touch, and giving the part a malignant appearance; the patient eventually falling into a cachectic condition, and becoming exhausted by the hemorrhage and discharges. In other cases, these tumours may degenerate into a spongy calcareous mass of a brownish colour and hard consistence; but they never undergo proper ossification. More rarely the interior of these growths softens and undergoes absorption, so as occasionally to form cysts of large size, containing fluids of various shades of colour. Paget relates the case of a very large cyst of this kind formed by the hollowing out of a fibrous tumour of the uterus, which was twice tapped by mistake for ovarian dropsy.

The Treatment of these tumours is in a great measure palliative; but when they are so situated as to admit of removal, as in the neck, under the angle of the jaw, or in the antrum, they should always be extirpated.

2. *Semi-Malignant Tumours*.—The next class of tumours, most of which closely resemble the fibroid in structure, having a great tendency to recur

after removal, and to disintegrate and contaminate neighbouring parts, and even the system at large. They are in their appearance innocent, but in their course malignant. This class comprises the so-called *semi-malignant* tumours, viz., the Malignant Fibrous, the Fibro-Plastic or Myeloid, the Recurring Fibroid, and the Enochondromatous Tumours.

The *Malignant Fibrous Tumour* closely resembles in its general appearance and microscopic elements the ordinary fibrous growths; but its great characteristic is its recurrence after removal, with much tendency to ulceration, sloughing, and hemorrhage, forming not only in its original locality, but in internal parts of the body at a distance from it.

The *Fibro-Plastic or Myeloid Tumour* was first described by Lebert, and has been investigated by Paget, who finds it to stand intermediate in structure between the fibrous and fibro-cellular, appearing to consist of granulations in the process of development into fibro-cellular tissue, having parallel fibres with wide fibro-plastic cells, and occasional oat-shaped nuclei. It is found about the jaws, in the bones, the hands and feet, in the cellular tissue of the neck, over the parotid, in the mammary gland, and frequently in connection with the mucous cavities and canals, as in the nostril and nasal fossa (Fig. 161).

This tumour, the *Albuminous Sarcoma* of Abernethy, presents marked characters. On making a section, it cuts in a uniform, smooth, and somewhat elastic manner, it is semi-transparent, shining, and juicy-looking, of a greenish grey, bluish, or pinkish colour like the albumen of some birds'



Fig. 161.—Myeloid Tumour of Radius.

eggs, often spotted or stained with discoloured marks, varying in tint from a lilac to a pinkish, brownish, or livid red hue, which, if extensive, gives it a fleshy look; its structure is usually brittle. After a time it breaks down in the interior into a dark brown grumous glairy fluid, contained in cysts formed by the parenchyma of the growth. This tumour will grow to a very large size, sometimes slowly and gradually, at other times with very great rapidity. I have removed it from the parotid region when as large as the fist, and from the breast weighing as much as six pounds. It most commonly occurs in young people, without pain and without any known cause. In the majority of cases it may be safely removed without the prospect of recurrence, but occasionally, and without any apparent reason, it returns after removal. Most generally it is distinctly encapsuled when occurring in the neck and breast, and then may be extirpated with ease and safety, but if its degeneration have gone on to infiltration into the neighbouring structures, its recurrence will speedily take place. Lebert relates six cases of this disease in which recurrence took place after operation, with secondary deposits in internal organs.

The *Recurring Fibroid Tumour* has been described by Paget as closely resembling in general aspect the common fibrous tumour, whilst in its microscopic structure it is very like the fibro-plastic tumour, its most marked character being its tendency to recur after removal. Of this peculiar and hitherto undescribed disease, he relates several cases. One was a tumour of the upper part of the leg, which, between 1816 and the end of 1848, had been removed five times, and reappeared for the sixth time after the last opera-

tion, when, as it had become large and ulcerated, amputation was deemed advisable; this procedure, however, was followed by death. The examination of this tumour presented "very narrow, elongated, caudate, and club-shaped nucleated cells, many of which had long and subdivided terminal processes." In another case, a tumour of the shoulder had been removed, and returned four times between May, 1848, and December, 1849, re-appearing in the following year for the fifth time; it, however, after a time became stationary, and many years afterwards the patient, but for the presence of the tumour, might be considered to be a strong and healthy man. Paget also relates a case by Gluge, in which a similar tumour was five times removed from the scapula, its sixth re-appearance being followed by death. The most interesting of all is a case by Dr. MacLagan, in which, after three removals in the course of twenty-five years, no further recurrence of the disease took place, and the patient was in good health five years after the last removal. Since this form of tumour was first described by Paget, a number of instances have been recorded by British and Continental surgeons. It is a remarkable circumstance that these recurrent tumours appear to become more malignant in their growth in the later than in the earlier recurrences, acquiring more and more the characters of true malignant disease, becoming more painful, rapidly degenerating, and giving rise to an ulcerating fungus, which eventually proves fatal by exhaustion and hemorrhage.

3. *Enchondroma*, or the *Cartilaginous Tumour*, carefully studied by Muller and investigated by Paget, is an exceedingly interesting affection, whether we regard the peculiarity of its structure, its comparatively frequent occurrence, or the large size that it occasionally assumes. It takes place under two distinct forms; most commonly as an innocent growth, but in other cases assuming a malignant tendency and appearance. These two forms present different signs; in the first case, the enchondroma occurs as a hard, smooth, elastic, ovoid, round, or flattened tumour, of small or but of moderate size, seldom exceeding that of an orange, and growing slowly without pain. In the second form, it approaches in its character to malignant disease, growing with extreme rapidity, attaining an enormous size within a few months, and contaminating the system by the deposit of secondary enchondromatous growths in internal organs; under these circumstances, it would appear to have occasionally been mistaken for the rapidly spreading forms of encyphaloid disease.

But although occasionally assuming the course that is usually adopted only by true malignant growths, it must be borne in mind that enchondromata, especially of the testes, are not unfrequently associated with encyphaloid; and when this occurs, the secondary deposits are usually of the latter character only, although in some rare cases even these have been found of a mixed nature.

When these growths attain a tolerably large size, though occasionally whilst they are still but of moderate dimensions, ossification may occur in some parts, whilst a process of disintegration may take place in others, which soften, break down, and liquefy in their interior, causing the skin covering them to become dusky and inflamed, eventually to slough, and to form fistulous openings, through which a thin jelly-like matter is discharged. In some cases it would appear that large tumours of this description, softening in the centre, and becoming elastic and semi-fluctuating, have been mistaken for cysts, and have been tapped on this supposition. In small enchondromata the opposite condition more frequently occurs, the tumour becoming indurated, and undergoing ossification.

Microscopical Characters.—The accompanying cut is a good illustration

of the microscopical characters of enchondroma (Fig. 162). It shows a clear matrix, in some places finely granular, in others slightly fibrous, imbedded in which are cells and nuclei of various forms and sizes, some round or irregularly oval, from $\frac{1}{16}$ th to $\frac{1}{8}$ th of an inch in diameter. Many are branched or caudate, some of the spheroidal cells are granular, others have nuclei of irregular outline. Interspersed among them are a few oil-globules. The general appearance is that of fetal cartilage, from which it can with difficulty be distinguished.



Fig. 162.—Structure of Enchondroma.

Locality.—Most frequently enchondroma occurs in connection with some of the short bones, more particularly those of the metacarpus and the phalanges of the fingers, presenting hard rounded knobs in these situations, where, however, it seldom attains a greater magnitude than a walnut or a pigeon's egg. When large, it is commonly met with in or upon the head of the tibia, or the condyles of the femur, forming in these situations rapidly increasing growths of considerable magnitude. It may also form in the parotid region, in the muscular interspaces of the neck, thigh, and leg, and in the testes. When connected with the bones, enchondroma may either spring from the periosteum, gradually enveloping, absorbing, and eventually destroying, the osseous structures, though at first not incorporated with them. This is its usual mode of origin when occurring in the femur or tibia; when seated on the short bones, especially on the metacarpus and phalanges (Figs. 163, 164), it commonly springs from the interior of the osseous structure, ex-



Fig. 163.—Large Enchondroma of Index Finger

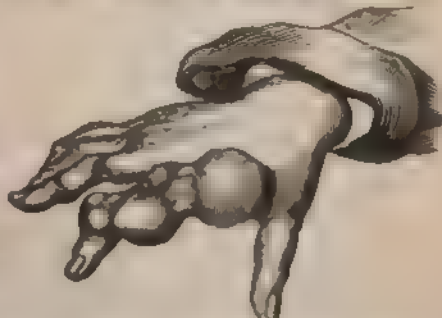


Fig. 164.—Ordinary Enchondroma of Finger

panding, absorbing, and involving its walls in the general mass of the tumour. When occurring in cellular regions unconnected with bone, the enchondroma is softer, and does not present such distinct cartilage-cells as the osseous enchondroma. Most frequently these enchondromatous masses occur in childhood, or shortly after puberty, appearing to arise from an overgrowth of the cartilaginous element of the osseous system at this period of life.

The Treatment consists either in excision of the tumour, or in amputation of the affected part. Excision may be practised when the tumour is seated in the parotid region, or otherwise unconnected with bone. When forming part of the osseous structures, it cannot well be got rid of without the removal by amputation of the bone that it implicates. When it occurs in the hand, removal of the affected fingers and metacarpal bones, to an extent

proportioned to the amount of the disease, will be required. In Fig 14 may be seen the kind of hand left after operation in the case from which Fig. 164 was taken. If, under these circumstances, excision of the tumour only be attempted, it will be found that the whole mass cannot be removed, and that it rapidly grows again; or that the wound formed by the operation remains fistulous and open. Most commonly a permanent cure is effected by the ablation of the tumour in one or other of these ways; but cases have occurred of the more rapidly growing form of the disease recurring, after its removal, in a softer state than before, and with a close approximation to malignancy in appearance and action.

It is worthy of remark, as showing the connection between enchondroma and malignant disease, that cartilaginous masses have been met with in the midst of encephaloid tumours of the bones and testes.

We have now considered innocent tumours, which have no tendency to contaminate neighbouring structures, or to return after removal; and the semi-malignant, which, though innocent in structure, are malignant in their course, and, under certain obscure conditions, local or constitutional, as yet undetermined, have a disposition to recur after operation. We next proceed to the study of that form of malignant growth which has, as it were, a natural and constant tendency to affect the system, to implicate neighbouring structures, and to return in its original site, or at a distance, after removal.

CANCER.*

Cancer differs from all normal structures, in being distinctly and essentially a new product, never, under any circumstances, existing in a healthy system, and possessing peculiar vital properties and organisation.

VARIETIES.—Cancer presents itself in four if not five varieties, which differ so much from one another in appearance, in rapidity of growth, in consistence, colour, and structure, as at first sight almost to appear to constitute essentially different diseases, but yet having so close a family resemblance and presenting so many points of identity that, physiologically speaking, they must be considered as mere varieties of the same class of tumour. The varieties of cancer generally admitted are *Scirrhus*, or the *Hard Cancer*; *Encephaloid*, or the *Soft Cancer*; *Colloid*, or *Gelatinous Cancer*; *Melanosis*, or *Black Cancer*; and *Epithelioma*.

We meet with cancer in one or other of these forms, usually the encephaloid, associated with some of the normal constituents of the body:—with cartilage, as *Chondroid*; with bone, as *Osteoid*; with an erectile vascular structure, as *Aneurismal*; and with epithelial cells, as *Epithelial Cancer*. Other varieties of cancer are met with, deriving their distinctive characters from some peculiarity of structure. Thus, when cysts are largely developed in the substance or in the surface, we have *Cystic Cancer*; and when the surface is dendritic and papillated, the disease is termed *Villous Cancer*.

CHARACTERS.—These various forms of cancer differ from one another in appearance and consistence; the *scirrhus* being hard, firm, semi-transparent, of a bluish or greyish colour; the *encephaloid* being brain-like in appearance, soft and hemorrhagic; the *colloid* resembling glue, or honey in its comb; the *melanosis* being black, sometimes solid, at other times liquid; and the *epithelial* form occurring as nodules or ulcers, presenting peculiar characters.

* It is not my intention to enter largely into the general history of malignant diseases, which will not admit of my doing so. I would, therefore, refer to readers who wish for further information on this interesting subject to the works of Abernethy, the papers by Lawrence, on Cancer, and most recently, "Illustrations of the Elementary Forms of Disease," by Sir R. Cameron, 1844, or select and copious treatises by Dr. Watson, and to Sir Paget's valuable treatise on the subject. In these different sources will be found nearly all the information at present possessed by the profession on this important and interesting subject of Cancer.

They vary also in the rapidity of their growth, in their vascularity, and in the order of their malignancy, and may be arranged as follows: 1. Scirrhus; 2. Encephaloid; 3. Melanosis, 4. Colloid; 5. Epithelial Cancer.

Great as the differences amongst them are, however, the points of resemblance are still more striking; thus, one form of cancer may take the place of another, or be associated with it; encephaloid occurring after the removal of scirrhus, or being associated with melanosis; or colloid and scirrhus being met with together in the same tumour. This identity of seat and of recurrence, which tends more than anything else to establish a common origin amongst these tumours, has been specially pointed out by Carcawell. Then, again, these tumours are all of a truly malignant character, having a tendency to induce a peculiar and similar condition of system that goes by the name of the *cancerous cachexy*. In chemical composition, also, they are nearly identical, being principally composed of albumen.

MICROSCOPIC STRUCTURE.—The microscopic characters of the different forms of cancer have of late years attracted considerable attention amongst pathologists. They consist, in all the varieties, essentially of the same elements, though these may differ somewhat in appearance, and in relative preponderance, in the different forms of the affection. In all there is a fibrous stroma or *læsis*, firmer and closer in some, as in scirrhus, than in the others. This yields by scraping or pressure a turbid fluid, termed the *Cancer-juice*, in which granules, cells, pigmentary and fatty matters, are found in varying proportion. The granules, which are minute, sometimes amorphous, at others presenting that peculiar vibratory condition termed the

molecular movement, are met with in all the varieties of cancer, though they occur in largest quantity in scirrhus. The cells have often been looked upon as characteristic or pathognomonic of the disease, though erroneously so in the strict acceptation of the term; they present, however, such peculiar characters, that it is almost impossible to mistake them. They are large, spherical, fusiform or spindle-shaped, elliptic or caudate, having often two or three ter-

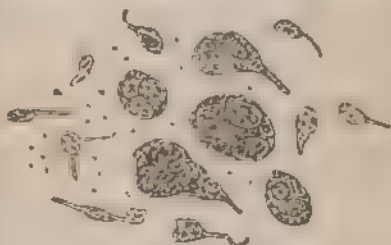


Fig. 165.—Cells from Scirrhus of Breast (rapidly recurring).

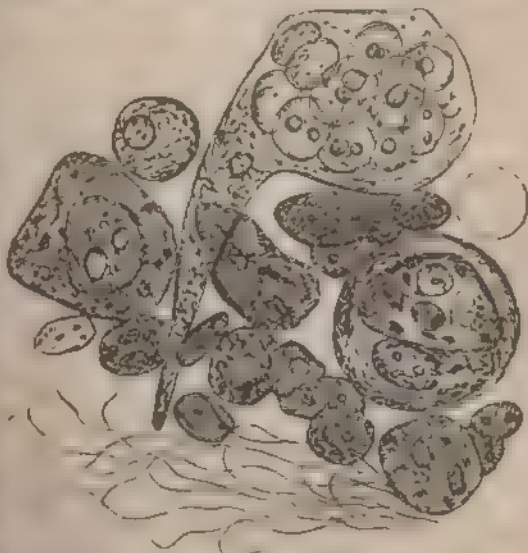


Fig. 166.—Cells from Encephaloid of Tongue (rapidly growing)

well-marked nucleoli (Fig. 165). These various appearances are presented in all forms of the disease; but especially in the encephaloid variety they assume a large size, and present their most marked fusiform and caudate shape (Fig. 166). The pigment-cells are mostly, if not altogether, found in melanoma.

Much diversity of opinion exists amongst surgeons as to the value that should be attached to these microscopic signs in determining the true nature of many tumours; some being guided by these appearances alone, others looking upon them as uncertain and fallacious, and trusting rather to the general characters of the growth. The latter, however, appears to me to be too limited a view of the subject; for, although the unaided eye of an experienced surgeon may in many cases recognise the true character of a tumour, and the microscope in some few instances fail to reveal it, yet there can be no doubt that in most cases it is only by the aid of this instrument that the real nature of the growth can be absolutely determined.

It is doubtless true that every one of these microscopic elements may separately occur in the normal tissues and secretions of the body, some in those of the adult, others, as the caudate and fusiform corpuscles, in the embryo: but though this be the case, it does not appear that they are ever found in any tumours, except those of a cancerous nature; and in these it is rather by the aggregation of these appearances, than by any single one in particular, that the true character of the disease is determined. In these examinations, however, the experienced surgeon will find that the appearance presented to the naked eye will assist him much in pronouncing upon the malignant or cancerous character of the tumour. It is certainly a remarkable circumstance, that the "recurring" or semi-malignant diseases, as well as those that are truly cancerous or positively malignant, present under the microscope structures that closely resemble those of tissues in process of development, either in the form of imperfect exudation-matter and intercellular tissue, as in the fibro-plastic tumours, or in the similarity of the corpuscles of encephaloid to some of those of the soft tissues in the embryo.

PROGRESS.—The general characters that attend the progress of these several forms of cancer present numerous points of resemblance. When once formed, the tumour continues progressively to increase in size with a degree of rapidity, and to an extent, that vary according to its kind: the scirrhus tumour growing most slowly, and attaining but moderate dimensions; the encephaloid and colloid often with great rapidity, and to an immense size. When the full growth of the tumour is attained, the process of decay commences. The mass softens at some point, the skin covering which becomes dusky inflamed and ulcerated, an irregular sloughy aperture forming, through which the *débris* of the mass are eliminated in an ichorous or sanious fluid, having often a peculiar fetid smell. The ulcer then pretty rapidly increases with everted edges, a hard and knobby, or soft and fungating surface, and the discharge of a dark fluid, often attended by hemorrhage, and occasionally with sloughing of portions of the mass. Coincidentally with the implication and ulceration of the skin, there is usually deposit in the lymphatic glands with great increase of pain, and most commonly with the supervention of the constitutional cachexy; though in some cases the condition precedes the cutaneous implication. This cachexy appears to be the result of the admixture of cancer-germs with the blood, and their circulation through the body; or to some other modification in the condition of the blood, induced by the action of the morbid growth on the economy. The exhaustion resulting from the ulceration, sloughing, and consecutive hemorrhage, also commonly increases this cachectic state. In many instances it is not marked until after the skin has become affected, and in others it is

not supervene until ulceration is actually set up. In this cachexy the countenance is peculiarly pale, drawn, and sallow, so that the patient has a very anxious and care-worn look. The general surface of the body commonly acquires an earthy or yellowish tint, and not unfrequently large spots of pityriasis or chloasma make their appearance on various parts of it; the appetite is impaired, the voice enfeebled, the muscular strength greatly diminished, and the pulse weak. The patient complains of pains in the limbs, of lassitude, and of inability for exertion; he emaciates rapidly, and frequently suffers by the occurrence of cancerous deposits in internal organs; and at last dies from exhaustion, induced by the conjoined effects of weakening discharges, general debility, and pain.

These general characters of cancerous growths, however, present certain varieties of importance, according to the form of the disease that is developed.

SCIRRHUS.—The scirrhus, or *hard cancer*, is most commonly met with in the breast and lymphatic glands. It occurs in two forms; either as a circumscribed mass, or infiltrated in the tissue of an organ. In either case it forms a hard, craggy, incompressible, and modulated tumour, at first moveable and unconnected with the skin, but soon acquiring deep-seated attachments, and implicating the integument. It grows slowly, seldom attaining a larger size than an orange. It is painful, aching generally, at times with much radiating and shooting pain through it; these sensations vary according to the part affected, and to the sensibility of the individual; the pains are especially severe after the tumour has been handled, and at night are of a lancinating, neuralgic character. It may thus continue in a chronic state for a considerable length of time, slowly increasing, gradually extending its deeper prolongations and implicating the more superficial parts. In some cases, more particularly in elderly people, scirrhus gives rise to atrophy of the organ in which it is seated, causing wrinkling and puckering of the surrounding skin, which becomes adherent to the tumour; and the cancer may thus continue in a very chronic state.

The ulceration usually takes place by the skin becoming adherent at one point to the tumour, either by dimpling in, being as it were drawn down towards it, or else by being pushed forwards, stretched, and implicated in one of its more prominent masses; it then becomes of a dusky and livid red, somewhat glazed, and covered by a fine vascular net-work. Softening occurs at one point, where a crack or fissure forms; a clear drop of gummy fluid exudes from this, and dries in a small scab upon the surface; this is followed by a somewhat bloody discharge of a thick and glutinous character; and the small patch of skin from which it issues, becoming undermined, speedily sloughs away, leaving a circular ulcer. This gradually enlarges, becoming ragged and sloughy, with craggy everted edges, having irregular masses arising from its surface, and discharging a fetid sanious pus. The pain increases greatly; and, the lymphatic glands becoming involved, the cachexy is fully developed, and the patient is destroyed by it or by the secondary visceral deposits. In old people, ulceration of scirrhus masses often assumes an extremely chronic character, the growth in them not being endued with the same vitality as in the young. The ulcer in these cases is flat, sloughy, of a greyish-green colour, hard and ragged, with puckered edges, much wrinkling of the surrounding skin, and exhaling the usual fetid odour. In younger persons, and especially in stout women with florid complexions, this disease usually makes rapid progress. So also, if inflammation be accidentally set up in the neighbouring tissues, cancerous infiltration takes place in them, in consequence probably of the products of inflammation effused around the tumour undergoing cancerous transformation almost as soon as

deposited. I once had under my care an old man with a cancerous tumour of the leg, which, after remaining stationary for seven years, became accidentally inflamed, and afterwards increased with great rapidity. Occasionally, but very rarely, scirrhous masses slough out, leaving a large ragged cavity, which may even cicatrize; and thus a spontaneous cure has been known to occur. The cancerous infiltration will extend to a considerable distance around the tumour into integument which to the naked eye appears quite healthy, but with the microscope will afford unequivocal evidence of the existence of cancer-germs diffused through it. The cancer-infiltration extends like a halo around the original tumour, and very probably shades off into the surrounding textures. It is of great importance in determining the question of operation to bear this in mind, and not to act on the supposition of the tumour being distinctly and abruptly defined.

The secondary deposits from scirrhous tumours may take place in the viscera, more particularly the lungs or liver, or in the lymphatic glands. In the former situation, they are often of an encephaloid character, in the latter they assume the scirrhous form.

Structure.—After a scirrhous tumour has been removed, though still feeling firm under the fingers, it is not so hard as when it was in the body, owing, as Dr. Walshe observes, to the escape of its fluids and consequent loss of turgescence. On cutting it with the scalpel, it usually creaks somewhat and is divided, and presents a whitish or bluish-white glistening surface, intersected by white bands, which apparently consist partly of new structure, partly of included cellular tissue. This section has not inaptly been compared to the appearance presented by a cut through a turnip or an unripe pear, hence termed *napiform* and *apinoid* by Walshe; and from its reticulated character, *carcinoma reticulare*, by Müller. On examining the tumour stroma or net-work which forms the basis of the tumour, it will be found to be composed of fibrous or fibro-cellular tissue. The soft greyish-bluish granular material seated in the meshes of this, may be squeezed or scraped off in a liquid state as cancer-juice. This is composed of a multitude of nucleated corpuscles, granules, granular cells, and globular, caudate, or spindle-shaped bodies.

ENCEPHALOID.—The encephaloid or soft cancer, or, as it is often termed, *Medullary Sarcoma*, is the most malignant and rapidly growing form of this disease. It is met with in the globe of the eye, in the nares or other cavities of the face, in the articular ends of bones, in the testes, and the breast, and often attains an enormous size, equal to that of an adult head. It occurs in two stages; either as a tumour, encysted or infiltrated, or as a fungus after protrusion through the skin.

It commences as a tumour, which, though occasionally somewhat hard, is usually from the first, or at all events soon becomes, soft and elastic, being more or less lobulated, growing rapidly, and having an elastic and at last a semi-fluctuating feel. The skin covering it is usually at first pale and loose, with a large network of dilated veins spreading over it. In some cases, however, at a very early period, a species of inflammatory oedema occurs in the integuments covering rapidly growing encephaloid tumours. As the tumour enlarges, the skin becomes adherent, discoloured, of a purple-brown tint, and at last ulcerates at one point. When once the tumour has made its way through, and is relieved from the pressure of the fascia and integuments, the rapidity of its growth becomes fearfully increased, and a large soft fungous mass, rugged, irregular, dark-coloured, and bleeding profusely, rapidly grows forth, constituting the affection to which Mr. Hey gave the appropriate term of *fungus hematodes*; when this condition has been reached, death rapidly

arises from exhaustion and hemorrhage. Pulsation has been met with in particular forms of very vascular encephaloid; in these cases also a loud bruit synchronous with the pulsation and the heart's action has been detected, which may be heard on the application of a stethoscope. These symptoms have been most frequently met with in encephaloid tumours connected with bones, and may, unless care be taken, cause the disease to be confounded with aneurism.

The constitutional cachexy in encephaloid occurs early, and is well marked; and secondary affections of the lymphatic glands and viscera, occasionally of a scurvy character, often take place.

Structure.—After removal, the tumour is found to be very vascular, displaying on injection a close net-work of vessels. On a section being made, it commonly presents a soft pulpy white mass, closely resembling cerebral substance, stained and blotched with bloody patches, varying in colour from a bright red to a maroon-brown, this being dependent on blood that has been infiltrated into its substance. In other cases its section has been compared to that of a raw potato, or a piece of boiled udder. On closer examination, its tissue will be found to consist of a stroma of delicate fibres supporting the soft medullary or brain-like structure; this is composed in a great measure of large quantities of corpuscles, nucleated, compound, and granular, fusiform, angular, clubbed, or caudate, often with two terminations.

Colloid, Gelatinous, or Alveolar Cancer (if this formation can really be considered a cancer), may occur in distinct masses, often of a very large size, weighing many pounds, or may be infiltrated into the tissue of organs; as it is most commonly met with in the viscera, it does not so often fall under the observation of the surgeon as the other varieties of cancer. Yet it may form superficially. I have met with it in the breast, forming a very large tumour; and there is a preparation in the University College Museum of a scurvy breast containing colloid.

Structure.—It consists of cells filled with a clear semi-transparent yellowish gelatinous or honey-like material, resembling indeed exactly the structure of a honey-comb. The septa forming these cells are distinctly fibrous, and regular in their arrangement. The gelatinous matter contains caudate and nucleated cells in considerable quantity, presenting the same characters as those of the other varieties of cancer.

MELANOSIS OR BLACK CANCER has been specially studied by Sir Robert Carswell, who arranged it under the heads of *Punctiform Melanosis*, in which the dark pigmentary matter occurs in the shape of minute points or dots scattered over a considerable extent of surface; *Tuberiform Melanosis*, occurring in tumours which vary in bulk from a millet-seed to an egg or an orange, always assuming a globular, ovoid, or lobulated shape, and being principally met with in the cellulo-adipose tissue, or on the surface of serous membranes; and *Steniform and Lipiform Melanosis*, which takes place principally upon serous membranes, or in accidental cavities, where the black pigmentary matter looks not unlike Indian ink. Melanosis most frequently presents itself to the surgeon in connection with the eye, occasionally in the skin and subcutaneous cellular tissue, and rarely in the bones. It closely resembles in its general progress and characters the encephaloid form of cancer, ulcerating and throwing out dark fungous masses, and affecting like it internal organs, more particularly the eye and the lungs. Paget, indeed, regards melanosis as being, with very rare exceptions, merely medullary or encephaloid cancer modified by the deposition of black pigment. Occasionally, as Carswell has pointed out, it is distinctly associated with the other varieties of this disease.

Structure.—In microscopic structure it resembles encephaloid, consisting of a stroma, with caudate, granular, and compound cells, but containing a large quantity of pigmentary matter in granules, molecules, and masses.

DIAGNOSIS.—The diagnosis of the different forms of cancer is not always easily made. *Scirrhus*, when in tumour, may very readily be confounded with fibrous tumours and chronic glandular masses, or with the morbid atrophy of a part; in many of which cases, indeed, the diagnosis cannot be correctly effected until after removal. In other cases, however, the hard feel, the lancinating pains, the tendency to the implication of the lymphatics, or to affection of the general health, will commonly serve to establish its diagnosis. When ulcerated, the previous condition of the tumour, the general character of the sore, and the microscopic examination of the debris, may serve to establish its true character.

Encephaloid in tumour may be confounded with abscess, cysts, fatty, erectile, and sanguineous tumours; and, when pulsating, with aneurism. In these cases careful palpation, the existence of elasticity without fluctuation, and the presence of the large and tortuous veins ramifying over the surface of the mass, may establish its true character. When it is fungating, it might be confounded with the sprouting intracystic growths, that sometimes spring from the interior of a cystic tumour. Here, however, a microscopic examination of the debris, as well as the existence or absence of contamination of neighbouring lymphatics, will establish the true nature of the affection.

CAUSES.—The causes of cancer are often exceedingly obscure. In many cases it undoubtedly is of an *hereditary* character. Nothing is more common than to find that the grandmothers, mothers, or aunts of patients affected by cancer, have died of the same disease. Velpeau says that it was so in more than one-third of the patients he has met with; not that the disease itself is existent at birth, but that the tendency to it is connate; that tendency manifesting itself at those periods of life and in those organs in which cancer usually develops itself. It may, however, actually be a congenital affection; thus it has been met with in the eye at birth, and, in the Museum of University College, is a preparation of a small melanotic tumour existing in the cerebellum of a child that only lived three days after birth. It may occur at all periods of life from the earliest ages; and will evince itself in persons from eighty to ninety years of age. According to Dr. Walshe, the mortality from cancer goes on steadily increasing till the eightieth year: hence the popular belief, that the middle period of life is most obnoxious to it, would appear to be an erroneous one. Age, however, influences the liability to cancer in special organs. Thus cancer of the eye and of the bones frequently occurs in children; of the testes, not uncommonly, in young adults; whilst in the female, Mr. Sibley states that the average age of patients with uterine cancer is forty-three, and with mammary, forty-eight years. All forms of cancer are not, however, met with in equal frequency at all ages; the encephaloid being the most common in the young, and scirrhus in the middle-aged and elderly. Colloid rarely occurs before the age of thirty.

Cancer often appears without any *Exciting Cause*, when it is evidently, as in hereditary and connate cases, the result of some peculiar constitutional condition, the nature of which is altogether unknown to us, but under the influence of which the peculiar growth characterising it springs up. In many cases, however, it can be distinctly traced to some exciting cause, being immediately occasioned by a blow, injury, or other violence, or by a long-continued irritation of the part that eventually becomes affected; thus

in women a blow on the breast often gives rise to cancer, and the irritation of a broken tooth may occasion it in the tongue. It is a question whether external causes of this kind can give rise to the production of cancer without the previous existence of constitutional predisposition to the disease. That cancer, even when apparently excited by local causes, may in reality be of constitutional origin, cannot admit of a doubt; more especially in those cases in which it is hereditary, or in which it makes its appearance almost simultaneously in different parts of the body with a strongly marked cachexy. But in many other instances it certainly appears to be strictly local in its origin, as when it slowly occurs after the infliction of some violence, and without any evidence of constitutional disturbance or contamination. Velpeau truly observes, that those organs which are most exposed to external irritation and violence, are most liable to cancer. It is impossible to look upon those cancers as *ab initio* constitutional, which arise from external causes in an otherwise healthy individual, and slowly increase in size without any tendency to multiplication or sign of constitutional cachexy, until by the implication of the neighbouring lymphatics or glands the cancer-germs have entered and saturated the system. It is true, that it may be argued that the cancer could not be excited locally in these cases, unless a tendency to it already existed in the system. But this appears to me to be a begging of the whole question; there is no proof of the existence of any constitutional affection at the time of the occurrence of the disease, nor until it has existed for a sufficient length of time for the lymphatics to be affected and the blood to be poisoned; and it certainly appears to be more reasonable to look upon the local disease as the primary affection, occurring originally in a healthy constitution, but after a time infecting the system generally, than to regard the mere local manifestation as in itself a proof of the constitutional nature of the disease. It is true that we are ignorant of the manner how a cancer-germ can be produced by the local action of the part in which it is generated, but we are as little acquainted with the essential mode of production of an exulceration-cell or of a pus-corporuscle, which we know to be the results of strictly local action; and it seems to me that the difficulty is in no way solved, but simply pushed back a step by the attempt to prove that, in all cases of cancer-formation, a constitutional cause or predisposition exists, which impresses the cancerous character upon local actions taking place in such a system. The cases in which cancer appears to be primarily and strictly a local affection, influencing the constitution secondarily, are by no means of unfrequent occurrence. We commonly see, for instance, a woman in perfect health receive a blow upon the breast, which gives rise to some passing inconvenience at the time; after a lapse of some weeks, though still with an unimpaired state of health, she notices a small lump of a scirrhus character. This may continue stationary, or but slowly increase for months or years; and it is not until the lymphatics become enlarged, and the glands in the axilla indurated, that the constitution begins to suffer, cachexy sets in, and a tendency to secondary deposits manifests itself—the constitutional cachexy developing as the ulceration and abscess extend, and in exact proportion to the progress of the local affection. In such cases as these it is in vain to argue that the cancer could not have sprung up unless there were a constitutional tendency to it. There is in these cases no evidence of any affection of the constitution, nor of any general predisposition to cancerous disease, until after sufficient time has elapsed for the germs to be absorbed, and the blood to be poisoned by them.

The cause of *Secondary Deposits* in internal organs, as the lungs and liver, is somewhat obscure. It is probable that the cancer-germs are absorbed

into the blood, and thus carried into the system generally, and then deposited, like the pus-corpuscles in pyæmia, in certain organs, amongst which these just named stand pre-eminent; and that, when once deposited, each germ forms the nucleus of a new growth. But, though probable, this explanation yet requires the support of the absolute demonstration of the cancer-cells in the blood.

TREATMENT OF CANCER.—The treatment of cancer may be considered to be of a constitutional and of a local character. All *Curative Constitutional Treatment* is, I believe, utterly useless in cases of cancer, no constitutional remedies appearing to exercise any material influence on this disease. I am not acquainted with any case of cancer, either from my own observation, from conversation with other surgeons, or from published statements, that affords satisfactory evidence of cure by an internal remedy. It is true that many so-called cases of cancer have, at various times, been stated to have been cured by different medicines; but it must be borne in mind, that it is a less advanced state of pathological knowledge than exists at the present day, almost all hard chronic tumours were called "scirrhus," and many intractable ulcers, "cancers"; mistakes which are not unfrequently committed, and sometimes unavoidably so, even with the improved means of diagnosis that we at present possess. Not one of the many remedies that have been vaunted as being specific in this disease, and by which cures have been stated to have been effected, has retained the confidence of the profession, or has, on further trial, corresponded in its effects to the statements of those who introduced it. I therefore think it but waste of time to discuss the supposed advantage to be derived from hemlock, sanguaria, iron, arsenic, iodine, cod-liver oil, or lemon juice, in the treatment of cancer. But, though curative treatment can effect nothing in these cases, much may be effected in cases that do not admit of operation towards retarding the progress of the disease by proper *Palliative Treatment*. With this view, the diet should be mild, nutritious, easy of digestion, unstimulating, and sufficient to support the strength under the wearing influence of pain and discharge; and the preparations of opium, of conium, and of hyocyamus, must be freely administered in order to relieve the patient's sufferings, and to procure rest.

The *Local Means* are those upon which the surgeon justly places the chief reliance in these affections. The *Palliative Local Treatment* consists in the use of means calculated to retard the growth of the tumour, to lessen the pain attending it, and to remove the factor that arises if it be ulcerated. In order to prevent the rapid extension of the tumour, it is of great importance to subdue all local excitement going on within and around it, in proportion to the amount of action existing in the part, the disease will usually extend with rapidity; any inflammatory condition of the neighbouring tissues being especially prejudicial in this respect. Hence, under these circumstances, the occasional application of a few leeches will often be of considerable service. No counter-irritation, however, ought to be employed in the vicinity of the cancerous part, as it only excites action in and around it, and hastens the process of ulceration; the skin especially is apt to become rapidly infiltrated by the cancerous disease under it, if irritated by the application of iodine and other stimulants. If the tumour be painful, and the skin covering it still unbroken, great relief may be obtained by the application of belladonna plasters. In some cases I have found powdered conium, spread on cotton-wadding, useful in the same way. As it is of importance to prevent, as long as possible, any breach of surface, the application of these sedative plasters and powders should be persevered in with the view of supporting the integument. The local application of ice, so as to freeze the

tumour more or less completely, has been recommended of late years by Dr. J. Arnott; it may, possibly, in some cases retard the growth or lessen the pain, but there is no evidence to show that it can be considered as a curative agent. When the tumour is ulcerated, the faecor must be diminished by the application of weak solutions of the chlorides, or of Condyl's disinfectant, to which opiates may be advantageously added with a view of lessening the pain.

The *Curative Local Treatment* of cancer embraces three methods, viz.: destruction by caustics; absorption by pressure; and removal by the knife. All these local means are employed on one principle; viz., on the supposition that the cancerous tumour which it is proposed to destroy, to absorb, or to extirpate, is primarily a *local* disease: that if this local malady can be removed sufficiently early, constitutional infection may be prevented; and that, even if this have to some extent taken place, fatal contamination of the system may be retarded by the removal of the local source of that constitutional infection.

The great objection that has been urged against operating in this disease is, that cancer being assumed to be from the first a constitutional affection, it is useless to remove the local tumour, leaving the constitutional vice unrelieved. If this objection were tenable, it would apply to the removal of cancers in any way, and would have as much force against removing cancerous growth by caustic, by pressure, or by congelation, as by extirpating them by the simpler and speedier means of the knife, and in fact must lead to the conclusion that none but local palliatives are proper in this disease. For such an argument as this to have any value, it must first be shown that cancer is *ab origine* a constitutional affection, and that it is not a local disease in the first instance, which, being allowed to remain unchecked, will at last contaminate and poison the system. The evidence we possess would, however, rather lead us to the opposite conclusion; namely, that cancer, like syphilis, is primarily local, and only becomes secondarily constitutional. This opinion, which Velpeau strongly supports, is founded on the following reasons.

1. We constantly see cancerous tumours spring up in individuals who have always enjoyed perfect health, and who are to all appearances perfectly well at the time of the occurrence of the disease. As in these cases there is no evidence whatever of constitutional disease of any kind, it would be a begging of the whole question to assert that the existence of the local affection must of itself be taken as an indication of a constitutional cancerous tendency.

2. These tumours are not unfrequently the result of some local injury or irritation.

3. The constitutional health does not in the majority of cases appear to suffer until some months have elapsed; when, as the lymphatics or glands become implicated, or neighbouring tissues invaded, signs of cachexy are seen.

4. If the disease be removed before neighbouring parts have become contaminated, the health, if it have suffered, often improves materially.

5. In the great majority of cases the patient remains free from any recurrence of the disease for some considerable period.

6. In some instances no recurrence whatever takes place, the disease being eradicated from the system, which could not be the case if it were constitutional.

7. When a recurrence does take place soon after an operation, it is almost invariably either in the cicatrix or in its immediate neighbourhood, owing to

cancer-cells which had been widely infiltrated escaping removal, and subsequently developing into a new tumour. Were the disease constitutional, recurrence would be as likely to take place in other parts, or in internal organs, as it does when the operation has been too long delayed.

8. We observe the same tendency to recurrence after removal, and even to secondary deposit in distant organs, in other tumours which are incontestably primarily local, such as the fibro-plastic and the enchondromatous, and which only become constitutional in their more advanced stages, and in a secondary manner.

CAUSTICS.—The employment of caustics for the destruction of cancers, is of old date, and their use has, in all ages and countries, been resorted to by empirics, who profess to remove, by secret remedies less painful and more efficacious than the knife, tumours of a malignant nature. As their application, to use Velpeau's expression, requires neither a knowledge of anatomy nor of operative surgery, they have always been popular with many who have neither the knowledge nor the skill to use the knife. In this country, however, they have never enjoyed any very extended reputation, and in fact they have, perhaps, not been legitimately employed to the extent that they deserve, especially in ulcerated and recurrent cancers, or in those situated on the skin and muco-cutaneous surfaces as not to admit of being very readily or safely extirpated by operation.

The great objection to the use of caustics has been the severity and the continuance of the pain induced by them, lasting not only for hours, but for days—more intense and prolonged than any occasioned by the knife, and as it is usually necessary, in order to destroy effectually the morbid growth, to repeat the application of the caustic several times, the suffering is often greater than the most resolute patient can submit to.

The chief argument in favour of caustics is the statement that, when cancers are thus destroyed, they are less liable to relapse than when extirpated by the knife. There is, however, no positive evidence in proof of the truth of this dogma before the profession. It is not improbable that the chemical action of the caustics may extend so widely into neighbouring tissues as to destroy or render unproductive the cancer-cells by which they are infiltrated, and on the development of which the local recurrence of the disease depends. But it is impossible to believe that the mere method of removal of the local disease can influence the constitutional nature of the cancer. If secondary infection have taken place, it can signify very little whether the local disease be extirpated by the knife or by caustics. If no cachexy exist, it appears to me that the patient must be equally safe in whatever way the local disease is removed, provided it be thoroughly and effectually extirpated. Another advantage urged in favour of caustics, in the correctness of which Velpeau acquiesces, is, that enlarged lymphatic glands are more likely to go down under their use than when the primary cancer is extirpated by the knife. Some of the advocates of the use of caustics in the treatment of cancer pretend that the particular agent employed exercises on the morbid structure a specific action, which is confined to it, and does not extend to the neighbouring healthy tissues. But this assertion is entirely destitute of foundation.

The caustics that have been and that are employed in the treatment of cancers are very various. They cannot be used indiscriminately, and consequently we must briefly consider them separately.

1. The concentrated mineral acids, especially the anhydrous nitric and sulphuric, are often advantageously employed. The concentrated nitric acid may be usefully applied to small superficial cancerous ulcers; it rapidly

destroys the tissues, and does not spread too widely, but it is not potent enough for the destruction of tumours. The glacial sulphuric acid, rubbed into a black paste with powdered saffron, is the caustic which Velpeau extols as the most efficient in cancerous tumours, more particularly if of a fungating or bleeding kind. It converts the part to which it is applied into a thick, hard, carbonised eschar, with but little surrounding inflammation; and, as its action is rapid, the pain is not prolonged. On the separation of the hard slough, a healthily granulating cavity will be left, which cicatrises rapidly with much contraction. It also acts as a hemostatic, rapidly shrivelling and drying up large bleeding and discharging fungi.

2. The *caustic alkalis*, especially potass and lime, either alone or in combination, in the shape of the Vienna paste, or fused into sticks, are very energetic in their action; but they have the disadvantage of spreading widely if applied to a large surface, and, by softening or dissolving the parts, giving rise to a tendency to hemorrhage. They may, however, be advantageously applied to small cancers of the face.

3. Various mineral salts, more particularly the chlorides of antimony, zinc, and bromine, the acid nitrate of mercury, and the arsenious acid, are often employed with much success in the treatment of cancers, ulcers, and growths.

Of the various chlorides, that of zinc is the most useful. This is applied by being made into a paste with from one to four parts of flour, moistened with a little water, or by the pure chloride slightly moistened being spread on strips of lint. It must, in order to act, be applied to a raw surface; hence it is customary first to destroy the skin with nitric acid, and then to apply the chloride. M. Canquoin states that a paste, made of equal parts of the chloride and of flour, four lines in thickness, and applied for forty-eight hours, destroys the parts to the depth of one-and-a-half inch. When of less strength and substance, its action is proportionately limited. It may sometimes be used in the form of small sticks or pencils, which are pushed deeply in several directions into the substance of the part to be destroyed. In other cases, the tumour may be deeply and rapidly attacked by applying a layer of the chloride of zinc paste over the whole of its surface. The slough produced by this application is then incised, or scored longitudinally at equal distances of about half an inch, until the parts beneath, to which the caustic has not penetrated, are reached by the incisions so made; pieces of lint covered with the deliquesced chloride are put into them, and afterwards fresh incisions are made until the cauterising influence is extended to the bottom of the tumour, which finally sloughs out in a mass. Of the utility of the chloride of zinc as a caustic there can be no doubt; but the chief objection to its use is the intensity and continuance of the pain occasioned by it. This, however, may be lessened by an admixture of about a sixth part of morphia, or, as L. Parker has suggested, by freezing the part before the caustic is applied, and continuing the application of the frigorific mixture during the time of the action of the caustic. Landolfi has recommended the use of the chloride of bromine in combination with those of gold and zinc, but this caustic does not appear to possess any decided advantage over the simple chloride of zinc, and is objectionable on account of the fumes evolved during its use.

Arsenic exercises a powerful action upon cancerous growths, and constitutes the chief ingredient in many of the secret preparations used by empirics; it is, however, a dangerous agent, and excites great inflammation and pain. If too freely used, it may induce poisoning, and not a few deaths have resulted in this way. It should, accordingly, not be applied at any one time to a surface exceeding a shilling in size. The most convenient mode of

applying it appears to be Manec's paste, composed of one part of arsenious acid to eight of cinnabar and four of burnt sponge, rubbed down to a proper consistence with a little water.

Sulphate of zinc, dried, finely levigated, and made into a paste with glycerine, or an ointment with arunge, has been very strongly recommended by Dr Simpson, as one of the most efficient and convenient of all caustics in rodent and cancerous ulcers. In action it somewhat resembles the chloride of zinc, but is less painful.

Of all these caustics, I should certainly say that the deliquescent chloride of zinc is the safest and the most efficacious, more particularly when a scirrhus tumour has to be destroyed. When an encephaloid fungus has to be attacked, the concentrated sulphuric acid is preferable, owing to its coagulating and hemostatic properties. When small cancerous areas have to be destroyed, the nitric acid, the arsenical paste, or the chloride of zinc, made into a paste with flour and morphia, may very conveniently be used.

COMPRESSION is a plan that has been by turns greatly extolled and much depreciated. It was fully tried at the Middlesex Hospital, by Mr. Young, forty years ago, and unfavourably reported upon by Sir Charles Bell at that time; it consequently fell into disuse in this country, but was revived by Recamier in France, and employed largely by him. Although he published a favourable account of this practice, it made but little progress amongst French surgeons, the only one who seems to have used it to any extent being M. Tanchou, who employs a peculiar topical medication conjoined with it. In this country the practice fell into complete oblivion, until Dr Arnott, some years ago, invented a mode of employing pressure by means of an elastic air-cushion; since which time it has been pretty extensively employed, with varying degrees of success.

In employing pressure, Young principally had recourse to plasters and bandages. Recamier used amadou applied with an elastic roller; and Tanchou recommends spring pads, under which small bags or pieces of cotton-wadding impregnated with various medicinal substances are placed, so as to protect the skin and act upon the tumour. Dr. Arnott's plan consists of pressure exercised by a Mackintosh air-bag, held in its place by straps, and pressed upon by a truss-spring, the pressure exercised by which may be made to vary from two and-a-half to twelve or even sixteen pounds. These different plans should not be employed indiscriminately, but may all be of service in particular cases. I have employed all these methods, but have never found permanent advantage from any of them.

The first question that necessarily arises in reference to the employment of pressure in these cases, is whether it can effect a cure. This it could only be expected to do by producing atrophy, and the subsequent absorption of the strictly local forms of cancer. The only case on record, with any pretension to a conclusive character in this respect, is one related by Dr Walshe, in his excellent *Treatise on Cancer*, of the cure of a tumour of the breast, believed to be cancerous, by compression. But even this instance I cannot look upon as by any means conclusive; for, although no one can entertain a higher opinion than I do of the very remarkable diagnostic tact possessed by Dr. Walshe, yet I think there can be no doubt in the mind of any surgeon that it is absolutely impossible to determine in many cases, by any amount of diagnostic skill, the true nature of a chronic tumour of the breast; and, in fact, we constantly see the most experienced practitioners find, after the removal of the tumour, that it was of a different character from what they had previously anticipated. This difficulty attaches to Dr. Walshe's case; and I think that we possess no proof that the tumour of the

breast, which underwent absorption under the pressure of Dr. Arnott's apparatus, was of a truly cancerous character, and that it might not have been a chronic mammary tumour, or some similar growth, which we know will disappear under this kind of treatment.

But, if compression cannot be shown ever to have cured a cancer, can it not retard the progress of this disease, or relieve the sufferings attendant upon it? I believe that in some cases it may certainly do both, though in others it is as unquestionably injurious. It appears occasionally to retard the growth of the tumour when applied in the early stage, simply by preventing its expansion, and perhaps by compressing its nutrient vessels, and so diminishing the supply of blood sent to it, and by causing absorption of surrounding inflammatory infiltration; in these cases likewise it relieves for a time the pain by lessening the turgescence of the part. In other cases, however, I have known it to act injuriously by pressing out and diffusing the tumour more widely, appearing to increase the tendency to implication of neighbouring parts, and occasioning great suffering. When the tumour is ulcerated, or if the skin covering it be inflamed, pressure cannot be employed with any advantage; and most commonly irritable sensitive patients cannot support the constriction of the chest that it induces.

Excision.—With regard to the question of removing cancers by the knife, much difference of opinion exists amongst surgeons; for, though all deprecate indiscriminate recourse to this means, some go so far as to dispute the propriety of ever operating for this disease, whilst others restrict the operation to certain cases of a favourable character. These questions are necessarily of considerable importance, and require attentive examination.

The objections that have been urged against the general propriety of operating in cases of cancer, do not apply so much to the operation itself, the risk attending which is not greater than that of other operations of similar magnitude, but are rather based on the supposition that cancer is originally a constitutional affection, and on the consequent liability of the patient to speedily suffer from a return of the disease, so that an operation that is at least unnecessary will have been performed. This objection, however, as has already been remarked, equally applies to all other means of local removal, as by caustics or compression, as well as to extirpation by the knife; and, if carried to its logical conclusion, must necessarily preclude any attempt at removal, by any means, of the local disease. That this objection, so far as the liability to return of the cancerous disease after operation is concerned, is, however, to some degree a valid one, is undoubted; the experience of all surgeons tending to establish the fact, that the majority of patients operated upon for cancer die eventually, and usually within a limited time, from a recurrence of the disease. Thus, Sir A. Cooper states, that in only nine or ten cases out of a hundred did the disease not return in three years; and Brodie has found that it generally proves fatal in two or three years after the operation.

After removal of the original cancerous tumour, the disease may return in one of three situations, viz.: in the cicatrix; in the neighbouring lymphatic glands, with or without the cicatrix having been involved; or in internal organs. The mode of recurrence in these different parts is obvious enough. When the disease returns in the cicatrix, it is owing to local causes; either to the original cancer having been imperfectly removed, when recurrence will take place before the wound is healed, or very shortly after this event; or it is owing to the widely spread infiltration of cancer-germs through tissues that had a healthy appearance, when recurrence will take

place after a lapse of some weeks or months, in the shape either of uniform infiltration of the cicatricial tissue, which assumes the appearance of an elevated hard ridge of a purplish-red colour; or in the form of distinct small hard nodules of a purplish-red colour, which rapidly coalesce. When it recurs in the *lymphatic glands*, they have doubtless contained the cancer germs before the removal of the original tumour. They become hard infiltrated, and often form secondary growths, rivalling the primary ones in size and rapidity of development. When the secondary deposit takes place in *internal organs*, it is usually met with in the liver or the lungs. In such cases it is reasonable to presume that the cancer-cells have entered the blood, are carried into the general current of the circulation, and are deposited just like the pus-corpuscles in pyæmia in these organs, where each cancer-germ forms the nucleus of a new growth.

Recurrent cancer, in whatever situation it develop, is more rapid in its course than the primary form of the disease. It may prove fatal in various ways; by exhaustion from local discharges or hemorrhage; by the induction of an anæmic cachexy, in which the nutrition of the system becomes so impaired that death results; or by the induction of internal disease of an acute character, as low pneumonia, pleuritic effusion, or ascites, according as the internal deposit is thoracic or abdominal. The disease is especially apt to recur soon if the skin have become involved, if the lymphatic glands be enlarged, or if there be constitutional cachexy before the operation; also if the tumour be growing rapidly at the time of removal, and especially if the patient be robust and strong, with a florid complexion.

In determining the question of operating in cases of cancer, several points of great importance present themselves to the consideration of the surgeon. He has first to consider whether the operation is likely to free his patient completely from the affection; or, in the event of its not doing so, whether at least life may not be prolonged by the removal of the cancerous tumour; and, lastly, even though the patient be eventually carried off as speedily as he otherwise would have been, whether his sufferings may not be much lessened by the removal of the local affection.

1. Can cancer be cured, or rather completely extirpated from the system by excision?

That in some cases a cancerous tumour may be removed with every expectation of the patient being completely freed from the disease, cannot, I think, be doubted; although it may be true that such instances are not of frequent occurrence. Yet they occasionally fall under the observation of surgeons, and would certainly tend to prove that the affection is not in all cases of a constitutional character, and that, if we can happily succeed in removing it during its local condition, there is a good prospect that the patient may be rescued from a return of the affection. Velpeau states that he has perfectly cured patients by the removal of cancerous tumours—at least that no return has taken place for 12, 15, or 20 years after extirpation. The evidence of Sir B. Brodie on this point is extremely valuable. Writing in 1846, that eminent surgeon states, that "So long ago as 1832, I removed a breast affected with a scirrhus tumour, and the lady is still in good health—at least, she was so last year. Since the operation she has married, and had children. Last year I was called to see a lady on account of another complaint, on whom I performed the operation thirteen years ago, and found that she continued free from the old disease; and, very lately, I have heard of another lady whose scirrhus breast I removed six years ago, and who continues well." The evidence of Mr. Ferguson is also very positive on this point, and he speaks in a manner with which I perfectly

agree. He says, "Nevertheless, as excision gives the only chance of security—a point on which most parties seem to agree—an operation should always be resorted to, provided the knife can be carried beyond the supposed limits of the disease; and, moreover, I deem it one of the duties of the practitioner to urge the patient to submit to such a proceeding." The opinion of these eminent surgeons, supported as it is by the general practice of the profession, tends to show that in some cases, at least, the disease may be extirpated from the system by excising the tumour before the constitution has become implicated.

2. If cancer cannot be actually cured by excision, may not life be prolonged and health improved by an operation?

I am decidedly of opinion that this is possible; and that, though a patient may at last be carried off by some of the recurrent forms of cancerous disease, health may have been improved, life may have been prolonged, and much suffering may have been spared by a timely operation. It may often be observed that, after the cancer has been removed, the digestion becomes stronger, and the patient gains flesh; the colour of the complexion returns, and the spirits greatly improve; the system being relieved from a source of local irritation, and the mind from a cause of disquietude that has undermined the general health of the patient. This is more particularly the case in encephaloid cancer, in which early removal of the disease is unquestionably successful, in many cases, in prolonging life. The observations of Mr Paget on this point are peculiarly valuable. He states the average duration of life of those patients labouring under this form of disease, in whom the primary affection is removed, to be about twenty-eight months; whilst the average life of those in whom the disease is allowed to run its course, is scarcely more than two years.

But I think that the introduction of anæsthetic agents into operative surgery has very materially altered the bearings of this important question. So long as an operation was a source of great pain, and of much consequent anxiety and dread, a surgeon might very properly hesitate in subjecting his patient to severe suffering with so doubtful a result; but now that a patient can be freed by a painless procedure from a source of much and constant annoyance, discomfort, and suffering, the surgeon may feel himself justified in thus affording him a few months or years of comparative ease, though he may be fully aware that, at the expiration of that time, the affection may return, and will then certainly prove fatal. Even then, the patient's condition may be much improved; for the recurrent is often less distressing to him than the primary disease, since, as it often takes place in internal organs, it is not attended with the same amount of local pain and distress.

In discussing the propriety of operating in a case of cancer, the surgeon can, however, have little to do with general or abstract considerations. He has to determine what had best be done in the particular case that he is actually considering; and it will serve him little, in coming to a conclusion as to the line of practice that he should adopt, to refer to the statistics of the gross results of operations, or to general comparisons between the results of cases that are not operated upon and those that are. The whole question narrows itself to the point, as to what should best be done in order to prolong the life, or relieve the suffering, of the particular individual whose case is being considered. In order to come to some definite conclusion on this, it is necessary to classify the different cases of cancer, and to arrange them under the heads of those in which no operation is justifiable; those in which the result of any such procedure would be very doubtful; and, those in which an operation is attended with a fair prospect of success.

1. *Cases not admitting of Operation.*—*a.* The operation ought never to be performed in those cases in which there are several cancerous tumours existing in different parts of the body at the same time. Here the disease is evidently constitutional, and cannot be eradicated by any series of operations. *b.* If the cancerous cachexy be strongly developed, or if the disease be hereditary, it is useless to remove a local affection; as the malignant action will certainly manifest itself elsewhere, or, perhaps, even speedily return in the cicatrix. *c.* If the tumour be of very rapid growth, and be still increasing, there would appear to be so vigorous a local tendency to cancerous deposit, that it will speedily develop itself again in the cicatrix. *d.* If the tumour be so situated that it cannot be completely and entirely extirpated by cutting widely into the surrounding parts, it ought not to be meddled with; otherwise the affection will to a certainty return in the cicatrix before it has closed. It is necessary to remove not only the tumour, but the surrounding tissues to some extent, even though apparently healthy. *e.* If the whole of the affected organ, as a bone, cannot be removed, or if the skin and glands be involved, it is useless to attempt the extirpation of the growth, as a speedy relapse may be confidently looked for. *f.* In the very chronic and indurated cancers of old people, it is often well not to interfere, as in these cases the affection makes such slow progress, that it does not appear in any way to shorten life, and the mere operation might be attended with serious risk at an advanced age.

2. *Doubtful Cases.*—Those cases in which the result of an operation is of an extremely doubtful character, but in which no other means offer the slightest prospect of relief to the patient, have next to be considered. *a.* Cancers of the eye, tongue, and of the testes, belong to this category, for, though more liable to return than similar affections of any other part of the body, yet they may be considered fit cases for operation, inasmuch as no other way has the patient the slightest chance of being relieved from his disease. *b.* In those cancers that are already ulcerated, the surgeon may sometimes operate in order to give the patient ease from present suffering, or, perhaps, as in some cases recorded by Brodie, with a view of prolonging the duration of life; but he can have little expectation of effecting a permanent cure. *c.* If the tumour be of so large a size, or be so situated, that its removal cannot be undertaken without so serious an operation as to occasion in itself considerable risk, the propriety of operating is always very doubtful.

3. *Cases proper for Operation.*—Those cases of cancer in which an operation is, in my opinion, not only perfectly justifiable, but should be urged upon the patient as affording the best prospect of preserving his life, are those in which the disease has appeared to originate from a strictly local cause in persons otherwise in good health, in whom there is no cachexy or hereditary taint. If the tumour be of a scirrhous character, slow in its progress, single, distinctly circumscribed, without adhesions to or implication of the skin or glands, and more especially if it be attended with much pain, or with immediate risk to life from any cause, and if the whole of the growth, together with a sufficient quantity of the neighbouring healthy tissues in which it is imbedded can be removed with care, the case may be looked upon as a fit one for operation.

In all encephaloid cancers also, early operation should be practised with the view of prolonging life.

An important question in connection with operations for cancer is, at what period of the growth they may be done with the best prospect of success. Most surgeons, taking a common-sense view of this question, are

in favour of removing the affection as early as possible; feeling that, as it is difficult to say when the local form of the disease becomes constitutional, it is safer to remove it as soon as its true nature has been ascertained; and I confess that I can see no advantage that can be gained by delay. The necessity for early operation in *medullary* cancer is admitted by all; but with regard to *scirrhous* cancer the opinion is entertained by some, that in many cases there is a better prospect of success if the operation be delayed; and it is stated by Hervez de Chégoin and Leroy d'Etiolles, that the result of those cases operated on after the cancer has lasted for some time, is more favourable than that of those in which an early operation has been done; the cancer often appearing to be arrested in its development and to localise itself as it becomes more chronic, and having consequently a less tendency to speedy return after removal. That the result of operations in such selected cases is favourable, is probable enough; as it may be reasonably supposed that the more active varieties of cancer, those that possess the greatest amount of vegetative activity and of reproductive power, may have acquired a condition unfavourable to operation, or even may have carried off the patient before any period of arrest in their growth has occurred, during which their extirpation could be practised with a fair prospect of success. In delaying operation there is, however, much danger lest valuable time be lost in the employment of means which, ineffective in arresting the disease, may become positively injurious by allowing time to the morbid growth to contaminate the glandular system, or to extend widely through neighbouring tissues. If we look upon a cancer as a parasitic growth which must necessarily destroy life, either by changes taking place in its own substance or by the contamination of the system, and which is intractable to all medication, whether topical or constitutional, we must look upon its extirpation as the only resource that Surgery offers; and we may assuredly infer, that the liability to constitutional infection and wide-spread local contamination, will be less in proportion to the early removal of the morbid mass.

EPITHELIOMA.

Epithelioma, though closely allied to the true cancers, differs from them in so many important respects that it requires to be considered as a distinct affection. It resembles the true cancers in its tendency to local infiltration and ulceration, in its extension to the lymphatic system, and in the induction of death by cachexy. It differs from them in its anatomical structure, in being invariably seated in the mucous, muco-cutaneous, and more rarely the cutaneous structures—always on the surface of the body; and in its not being attended by secondary deposits in the viscera.

CHARACTERES.—*Epithelioma* usually occurs in middle-aged or elderly people, and, being intimately connected with the mucous surfaces, is chiefly met with in the lip, tongue, mouth, eyelids, penis, uterus, vagina, anus, and scrotum; occasionally in the deep mucous canals, as the pharynx and œsophagus. The only exception to its occurrence on the surfaces covered by epithelial or squamous scales with which I am acquainted, is its appearance as a submucous tumour in the mouth and uterus, of which I have more than once seen instances in both of these situations; the tumours varying in size from a cherry to a small walnut, round, pedunculated, and fibrous looking, but presenting after removal the characteristic epitheliomatous structure.

Epithelioma is usually occasioned by the long-continued or frequently repeated application of some source of irritation, and may thus be established in constitutions otherwise perfectly healthy. The muco-cutaneous surfaces are its true habitat. These tubercles and malignant ulcerations that occur

in the purely cutaneous surfaces, as of the extremities and breast, are almost invariably if not universally of a scirrhus character. It commences either as a small flat tubercle or wart, which rapidly ulcerates; or it appears from the first as an intractable ulcer of limited size, with hard and everted edges, and a foul surface. It slowly spreads, and appears at first to be local, but after a time, contaminating the glands in the neighbourhood, it induces cachexy, and destroys the patient by exhaustion. Extensive deposits in the lymphatic glands in the vicinity of the parts affected, even deep in the submaxillary, iliac, and pelvic regions, invariably take place after the disease has lasted for some time. On examination, an epithelioma will be found to be composed of a fibrous basis, with a large quantity of condensed and morbid epithelial scales closely packed upon it. These scales so closely resemble those of the epidermis and epithelium, that they cannot be distinguished from them, but their arrangement is different; they are packed together in masses or balls, assuming a concentric arrangement, hence termed "concentric globes" (figs. 167, 168), and in these present a somewhat

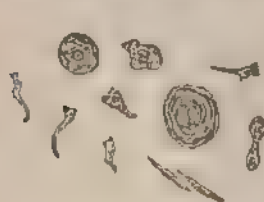


Fig. 167—Cells from Epithelial Cancer of Lower Lip.



Fig. 168—Cells from Chloasma.

fibrous appearance. According to Mr. Simon, however, this fibrous structure is deceptive, depending upon the scales being much attenuated and woven together. In many cases they are intermixed with globular bodies,

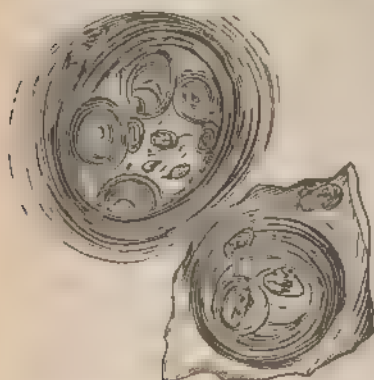


Fig. 169—Concentric Globes of Epithelioma.

and in others with cells of various shapes, resembling those found in the more truly cancerous diseases (Figs. 167, 168). But although the local characters of an epithelioma may in some cases be distinguishable with difficulty from those of true cancer, there is a very important pathological difference between the two diseases, for in epithelioma those secondary affections of the viscera which are so common in and characteristic of true cancer do not occur. When epithelioma proves fatal, it is by the progress of the local disease, by its extensive ulcerations; by the con-

tamination of the neighbouring lymphatic glands; and by the consequent induction of a constitutional cachexy and malnutrition, with exhaustion of the system. But those secondary tumours which are met with in the liver, lungs, &c., indicative of a deeper contamination of the system than is shown by glandular deposits, and which are the characteristic and almost invariable accompaniment of true cancer, do not occur in epithelioma.

DIAGNOSIS.—The diagnosis of epithelioma from true cancer is not always easy. The principal points that would guide the surgeon are, 1. The almost variable occurrence of the epithelioma on the mucous or muco-cutaneous surfaces. 2. Its early ulceration; often from the very commencement, as the primary form of the disease. 3. The tendency to spread by ulceration rather than by new deposit. 4. The origin of the disease from some evident source of external irritation. 5. The absence of all evidence of contamination of internal organs. In making the diagnosis, it must be borne in mind that scirrhus, when affecting the mucous or cutaneous surfaces, usually commences as a tubercle; and that, when this ulcerates, the base of the ulcer has a hard and deeply infiltrated feel, extending for some distance into the tissue, whereas epithelioma is never superficial, and is ulcerated rather than uncerclated and infiltrated.

The Prognosis of epithelioma is far more favourable than that of true cancer in any of its varieties.

TREATMENT.—The treatment of epithelioma is far more satisfactory than that of the true varieties of carcinomatous disease which we have just been considering, inasmuch as this partakes more of the characters of a local, and less of a constitutional affection, than the true forms of cancer. Hence early and free removal by excision or ligature, or complete destruction by caustics, will not uncommonly permanently rid the patient of this affection. Indeed, if the operation be done sufficiently early, I believe there is little liability for the disease to relapse. I am acquainted with several cases in which from six to ten years have elapsed from the date of the operation, without a sign of a tendency to recurrence of the disease. But great risk of recurrence arises from the delay of operation and the employment of inefficient means. The operation may be successfully practised at almost any age. I have removed an epithelioma of the tongue from a man 85 years of age with perfect success.

Excision should always be preferred whenever practicable, and should be done as soon as the nature of the disease is recognised, the part being thoroughly extirpated with a wide margin of tissue on each side of and beneath it, so that no cancer-germs may be left from which new growths can spring. When the neighbouring lymphatic glands are but slightly enlarged, the operation may still be done; the glandular enlargement, which may be dependent on irritation, gradually subsiding. If, however, it be more considerable, the affected gland must be extirpated; but if there be a chain of enlarged glands, more especially in the deeper cavities, no operation should be undertaken, as the disease will then have become constitutional and cannot be fully removed. If the disease be situated on one of the extremities, as the hand or foot, partial or complete amputation may be the safest procedure; and such cases are less liable to relapse than others in which such free extirpation is not admissible.

The *Ligature* may be advantageously employed when the cancer is so situated that incision is impracticable, either on account of dangerous hemorrhage or from the impossibility of effectually extirpating the disease. The part having been well insulated, and effectually strangled by stout whip-cord ligatures, sloughs and separates in a few days.

The *Écraseur*.—A more rapid process of strangulation has been invented by M. Chassagnac. By means of the *écraseur* (Fig. 170), canceroid and other growths of considerable size are removed with little or no hemorrhage, in the course of a few minutes, by a process of rapid strangulation and crushing in a linear direction. The *écraseur* consists of a loop of fine steel chain, which having been passed over the tumour or through the tissues to be removed, is gradually tightened by a mechanism in the stem to which it is

attached. In applying this instrument it is often necessary, first of all, to insulate and raise the tumour to be removed by passing a thread through it



Fig. 170.—Écraseur.

under it (Fig. 171); and then, having applied the chain's loop round its base to tighten this and effect the strangulation by working the handle every ten or fifteen seconds, until the mass is detached. The resulting wound is



Fig. 171.—Écraseur applied.

small and puckered in, and often heals with but little trouble. If the mass to be removed is large, two or more écraseurs may be used at the same time, the chains having been passed through the tissues by means of a needle. This instrument appears to me to be chiefly applicable to cases in which, as in canceroid ulcer of the tongue, excision is hazardous on account of the hemorrhage attending it, while the ligature is objectionable on account of the fetor and discharge resulting from the slow separation of the constricted mass, which sloughs and becomes putrescent. The French surgeons, however, extend the use of the écraseur to many cases in which in this country the ligature or the knife is preferred. They suppose that pyæmia is less likely to follow removal by this instrument than by the more ordinary means, purulent absorption less readily occurring while the vessels on the cut surface are crushed together. Whether this be really so, remains to be proved.

Caustics.—In some instances, the disease being so situated, as in some parts of the face, or in the deeper cavities of the body, that it cannot be dissected out, the application of caustics will be useful in procuring its removal; but if these agents be employed, care should be taken that they be freely applied and be sufficiently strong, so as thoroughly to destroy the whole of the morbid textures. Inefficient caustics, such as nitrate of silver, irritate and do not destroy the tissues to which they are applied, and in this way do much mischief. Inflammation is excited around the canceroid growths, plastic exudation takes place, and this becomes rapidly infiltrated by the abnormal structure, which thus rapidly extends. The best caustic preparations are the concentrated sulphuric acid, arsenic, the chloride of zinc paste, fused potassa cum calce, the potassa fusa, the Vienna paste, and the acid nitrate of mercury (vide p. 492). All of these may be applied

unsuccessfully, though they should not be used indiscriminately. The chloride of zinc and the Vienna paste are most useful when the ulcerated surface is large, and indurated at its base or edge. The acid nitrate of mercury should only be employed when the sore is small, superficial, irregular, and without much induration. In such cases also the arsenical pastes and powders already described are very useful. In epithelial cancer constitutional treatment is, I believe, as ineffectual as in the other varieties of the affection.

When a recurrence takes place after operation for epithelioma, it is either by a fresh deposit of cancerous matter in the cicatrix, or else by the neighbouring lymphatic glands which had been contaminated before the operation, continuing to enlarge, and at last ulcerating, and thus destroying the patient by cachexy and exhaustion, but without the occurrence of secondary deposits in internal organs.

EXCISION OF TUMOURS.

In describing the different forms of encysted tumour, the operative procedures necessary for their removal have been adverted to. We may now conveniently consider the steps that are generally necessary for the extirpation with the knife of solid tumours from the soft parts.

In the removal of tumours, the first point to be attended to is the arrangement, shape, and direction of the necessary incisions. These should not only have reference to the size of the growth, extending well beyond it at each end, but must also be planned with due regard to subjacent parts of importance. As a general rule they should be carried in the direction of the axis of the limb or part, and parallel to the course of its principal vessels; they must not only extend over the whole length of the tumour, but also a little beyond it at each end; no cross-cuts should be made, if they can possibly be avoided, and this may usually be done by the proper position and extension of the linear incision. In most cases, no skin should be removed, a simple cut being made; but if the integumental tissues be either very abundant and loose, or else adherent, an elliptical portion of them may be excised together with the tumour. In other instances, again, a semilunar flap of integument may with advantage be turned up from the tumour, the surface of which is then fairly exposed; this, however, can only be done in some simple tumours, such as fatty growths. The flaps covering the growth should then be freely but cautiously dissected back, so as to expose its sides and base; as these are approached, and the surgeon reaches the neighbourhood of its more important and deeper connections, increased care will be necessary, as it not unfrequently happens that the tumour is in more important relations with deep-seated blood-vessels and nerves of a large size than would at first appear.

When practicable, the deep dissection will best be commenced and carried out from that part of the base of the tumour into which the principal blood-vessels appear to enter; they are thus early cut, and being once ligatured give no further trouble, which they would do were they divided from the direction of their branches towards the trunk, when at each successive stroke of the knife a fresh portion of the vessel would be touched. In carrying on this deep dissection, the operator should proceed methodically from one side of the tumour to the other, the assistants holding aside the skin so as to give as much room as possible, whilst the surgeon himself, seizing the mass with his left hand, or with a large double hook or visellum, and dragging it well forwards, uses the knife by successive strokes, but in a leisurely and careful manner, avoiding all undue haste, until he completely detaches it from its connections. The safety of contiguous important structures will be

best secured by keeping the edge of the knife constantly directed toward the tumour, if this be of a non-malignant character; by attention to this rule, I have seen Mr. Liston remove tumours with remarkable facility and ease from the neighbourhood of most important parts. If, however, the growth be of a malignant character, the incisions must be made wide of the disease into the healthy structures around; if this be not done, slices of the tumour may be left from which fresh growths rapidly sprout, or cancerous matter may impregnate the neighbouring tissues through which they are scattered, and may eventually become so many fresh centres of malignant action.

After the tumour has been removed, it must be carefully examined, with the view of ascertaining whether it is entire; and, if any portions have been left behind, these must be properly dissected out. In some situations, as the axilla, or side of the neck or groin, where the relations are of great importance, the less the edge of the knife is used the better, and the growth should be enucleated by the surgeon's fingers or by the handle of the scalpel. If it be found that the tumour extends more deeply than had been anticipated, and comes into such close relation with important vessels, as at the summit of the axilla or in the perineum, as to prevent the surgeon from dissecting it out without imminent risk of destroying the patient, the only alternative left is one that I have seen Mr. Liston adopt, and have had occasion myself to practise in these situations; viz., to throw a strong whipcord ligature above the apex of the growth as high up as practicable, and then to cut off everything below this. On the separation of the ligature, any portion of the tumour that has been included will be brought away as if it had been removed by the knife.

In some cases it will be found, after dividing the fascia covering the tumour, that the attachments of the growth are not so firm or deep as had been previously expected; this is especially the case in some large tumours springing from the side of the neck and the parotid region, or in the groin; it may then often be removed in a great measure by separating the cellular tissue with the handle of the knife, merely dividing those portions of the deeper attachments that are of a peculiarly dense character. The surgeon should never undertake the removal of tumours that cannot be wholly and entirely extirpated, as the part left behind will always grow with greatly increased rapidity, often assuming a fungous character; this is especially the case with malignant tumours, the rapidity of increase of which is greatly augmented by partial operations. Should, however, the surgeon have been deceived as to the depth and connections of the mass, and should he find, after commencing his operation, that it is so situated as not to admit of entire removal, he must, under the circumstances, do his best, and cut off or remove by ligature as much of the growth as he can safely expose.

The wound that is left after the removal of a tumour usually unites partly by adhesive inflammation, and partly by the second intention; it should be lightly dressed, the edges being brought together by a few points of suture, with strips of plaster and water-dressing, and if large, supported by a compress and bandage.

CHAPTER XXXV.

SCROFULA, OR STRUMA.

By *Scrofula* is meant a peculiar constitutional condition, either hereditary or acquired, that leads to the formation of, and in its full development is characterised by the presence of, *Tubercle*. It is, however, only when fully developed, that scrofula gives rise to the local deposit of tuberculous matter. The constitutional condition that tends to this is sufficiently characteristic; but although we may recognise its existence, and speak of the individual possessing such a constitution as having a scrofulous tendency or diathesis, he can scarcely be considered to labour under the fully formed disease unless tubercle be deposited in some of his tissues or organs.

SCROFULOUS DIATHESIS.—This is a peculiar constitutional state that is often erroneously confounded with general debility. It may, and often does, co exist with this, but is by no means synonymous with weakness of constitution. Debility often exists without any scrofulous tendency or taint, more particularly in individuals of the nervous temperament; many delicate people, though weak, being perfectly healthy, and showing no disposition to this peculiar affection; on the contrary, the scrofulous constitution is often conjoined with much muscular power and mental activity. But though no weakness may be manifested in either of these respects, scrofula is invariably conjoined with debility or perversion of the nutritive activity of the body. This is especially manifested in certain tissues, such as the mucous and the cutaneous; and in those organs, the vitality of which is low, as the lymphatic glands, the bones, and the joints. In these, scrofula is especially apt to influence the products of nutrition and of inflammation, more particularly during the early periods of life, when these actions are most energetic, in such a way as to render its existence evident to the surgeon. It is this tendency to the occurrence of particular diseases, and to the engrafting of special characters on affections of certain tissues, that may be considered as specially indicative of the existence of the scrofulous diathesis; of that condition which, in its extreme of development, gives rise to the deposit of tubercle in organs and tissues. The existence of this diathesis is marked by the presence of a peculiar temperament; by special modifications of the seat, form, and products of inflammation; and, lastly, by the development of tubercle.

The *Scrofulous Temperament* assumes two distinct forms, the fair and the dark, and each of these presents two varieties, the fine and the coarse. The most common is that which occurs in persons with fair, soft, and transparent skin, having clear blue eyes with large pupils, light hair, tapering fingers, and fine white teeth; indeed, whose beauty is often great, especially in early life, being dependent rather on roundness of outline than on grace of form; and whose growth is rapid and precocious. In these individuals the affections are strong, and the procreative powers considerable; the mental activity is also great, and is usually characterised by much delicacy and softness of feeling, and vivacity of intellect. Indeed, it would appear in such persons as these, that the nutritive, procreative, and mental powers are rapidly and energetically developed in early life, but become proportionately early exhausted. In another variety of the fair scrofulous temperament, we find a coarse skin, short and rounded features, light grey eyes, crisp and curling sandy hair, a short and somewhat ungainly stature, and clubbed fingers.

but not uncommonly, as in the former variety, great and early mental activity, and occasionally much muscular strength.

In the dark form of the scrofulous temperament we usually find a somewhat heavy, sullen, and forbidding appearance; a dark, coarse, sallow, or greasy-looking skin; short, thick, and harsh curly hair; a small stature, but often a powerful and strong-limbed frame, with a certain degree of torpid languor of the mental faculties, though the powers of the intellect are sometimes remarkably developed. The other dark strumous temperament is characterised by clear dark eyes, fine hair, a sallow skin, and by mental and physical organisation that pretty closely resembles the first described variety of the fair strumous diathesis.

In all these varieties of temperament, the digestive organs will be found to be weak and irritable. This condition, which I believe is invariably associated with struma, and the importance of which has been pointed out by Sir James Clark, must be regarded as one of the most essential conditions connected with scrofula, and as tending greatly to that impairment of nutrition which is so frequent in this state. This gastric irritability is especially characterised by the tongue, even in young children, being habitually coated towards the root with a thick white fur, through which elongated papillae project, constituting the "pipped" or "strawberry" tongue; the edges and tip, as well as the lips, being usually of a bright red colour. This state of the tongue is aggravated by stimulants, high living, and the habitual use of purgatives. In the fair varieties the bowels are usually somewhat loose, but in the dark forms of struma there is a torpid condition of the intestinal canal. In all cases the action of the heart is feeble, the blood is thin and watery, and there is a tendency to coldness, and often to clamminess of the extremities.

STRUMOUS INFLAMMATION.—One of the most marked characteristics of struma is certainly the peculiar modification that inflammation undergoes, whether we regard the course that it takes, the form that it assumes, its products, or its seat. The course of inflammation in strumous subjects is always slow, feeble, and ill-developed, the more active and sthenic conditions being rarely met with. In its form it is usually congestive, ulcerative, or suppurative, and in its products it is characterised by little tendency to adhesion, by the production of thin, blue, weak, and ill-developed cicatrices, and by the formation of thin, curdy pus; with much shreddy, corpuscular lymph.

The seat of strumous inflammation varies greatly; and peculiar modifications of course, form, and products are assumed, according to the part that it affects. The tissues implicated by it are chiefly the skin and mucous membranes, the joints, and the bones, occasioning a great variety of special diseases, according as one or other of these structures are affected. It is as the result of, or in connection with these local affections that the general symptoms of struma become most marked. Whatever the variety of temperament may be, the individual usually emaciates, becomes sallow, cachectic, and debilitated, and at length falls into hectic or marasmus.

When affecting the *Skin*, scrofula declares itself under a variety of cutaneous eruptions, especially the different forms of eczema of the scalp, and various ulcers on the surface, usually weak,



Fig. 172.—Scrofulous Ulcer of Leg.

and largely granulating, with considerable swelling of the surrounding parts, and a tendency to the formation of thin blue and glazed cicatrices (Fig. 172). The integuments of the whole of the limb may become so much diseased in this way, cedematous, infiltrated and covered by flabby ulcers and fistulae, the member being perhaps double its natural size, that amputation is the sole resource. This condition is met with in the arm and foot, and removal of these parts may then be necessary.

The *Mucous Membranes* are commonly extensively affected, and often present the earlier forms of scrofulous disease in childhood; this is more especially the case with those of the eyelids and nose. The conjunctiva becomes chronically inflamed, perhaps with ulceration of the cornea. The mucous membrane of the eyelids may be permanently congested and irritated, with loss of lashes, constituting the different forms of psorophthalmia. The mucous membrane lining the nostrils becomes chronically congested, red, and swollen, giving rise to habitual sniffling of the nose, and to a sensation as of a constant cold. Occasionally that lining the antrum becomes irritated, and may then occasion an enlargement of this cavity, or the discharge of unhealthy pus into the nostrils. The tonsils are often found chronically enlarged and indurated, with occasional tendency to fresh inflammation; and the larynx may become the seat of various forms of aphonia, dependent on congestion of its lining membrane. The state of the gastrointestinal mucous membrane has already been described when speaking of the state of the tongue; and that of the genito-urinary organs is also marked by a tendency to debility and irritation, indicated by discharges from the urethra under the influence of very slight exciting causes, and often very permanent in their character. The occurrence of calculus of the bladder, especially in children, may also occasionally be attributed to the scrofulous diathesis.

Perhaps the most important local diseases arising under the influence of this agency are those of the *Bones and Joints*. The bones are liable to the occurrence of various forms of caries and necrosis (Fig. 173); more especially those that are spongy in their texture, as the short bones of the foot, and the articular ends of long bones. The joints are liable to that large class of affections that are commonly included under the term of *white swelling*, which consists of thickening, disorganisation, ulceration, and suppuration of the synovial membranes and cartilages.

Lastly, some of the *Glandular Organs* are peculiarly prone to scrofulous disease. Enlargement of the lymphatic glands, more particularly by the side of the neck and under the angles of the jaw, is of such frequent occurrence, and is usually so early a sign, that the surgeon, in determining whether an individual is scrofulous or not, commonly passes his hand over the glands in this situation in order to ascertain their condition and size; these glandular enlargements are especially apt to run into unhealthy and chronic suppuration. The testes and the mammae are occasionally affected; but other glandular structures, though sometimes implicated, are by no means so commonly found diseased as those that have just been mentioned.

TUBERCLE.—The occurrence of tubercle must be looked upon as the great



Fig 173.—Scrofulous Ulcers of Arm and Finger

characteristic of scrofula; and when it happens, it may be considered a sign of this affection, which has then reached its ultimate development. In those cases in which the scrofulous diathesis exists without having given rise to this product, it must be considered as not having been called into full and active operation, having merely manifested itself in the minor forms of disease, such as ulceration of the skin and of the mucous surfaces.

Tubercle, though sufficiently well marked by its appearances and progress, cannot be looked upon as a specific affection, but must be considered to be a perverted or unhealthy development of the nutritive materials destined for the repair of the body and the restoration of the blood. According to Mr. Simon, it consists of a disease of the lymph, or nascent blood. It is a "dead accretion," a "fibriniform product; insusceptible of development." "The scrofulous diathesis," says Mr. Simon, "consists in a peculiarity of blood development, under which the nascent blood tends to molecular death by superoxydation." According to Dr. C. J. B. Williams, "Tubercle is a degraded condition of the nutritive material from which the old textures are renewed, and the new ones formed; and it differs from fibrine or coagulable lymph not in kind, but in degree of vitality and capacity of organisation."

Tubercle essentially occurs in two forms. It is met with as semi-transparent grey granulations, smooth, and cartilaginous in look, somewhat hard, closely adherent, and accumulated in groups, often with a good deal of inflammatory action in the surrounding tissues. These grey granulations, usually about the size of a small pin's head, appear to consist of mucous exudation-matter. They have a tendency to run into masses, and to form the true yellow tubercle, which is met with in opaque, firm, but friable concretions of a dull whitish, or yellowish colour, homogeneous in structure, and without any appearance of vascularity.

The microscopic characters of tubercle present no very specific appearances (Fig. 174). We find that this product presents, under the lens, a homogeneous stroma, which chiefly occurs in the grey granulations; a granular



Fig. 174.—Tubercle.

matter, which is principally met with in yellow tubercle; drops of molecular oil; and, lastly, considerable quantities of imperfectly developed small exudation-cells, often angular, or broken at one side, more or less disintegrated, stationary, or degraded. Indeed, we



Fig. 175.—Pus.

must often recognise tubercle by its negative rather than its positive characters—by ascertaining what it is not; and so, by a process of exclusion, arriving at its true nature. It is most easily confounded with pus (Fig. 175) from which, however, the appearances differ sufficiently to avoid error, if a little care be taken.

The progress of tubercle is most commonly to disintegration and liquefaction, at the same time that it gives rise, by its irritation, to inflammation and suppuration in the surrounding tissues; hence it commonly leads to abscesses, the pus of which is always curdy and shreddy. In some cases, tubercle may become indurated, and undergo a species of calcification.

CAUSES.—The causes of scrofula, unless this be of a hereditary character, though very various in their nature, are usually such conditions as influence injuriously the nutrition of the body.

The *Hereditary Nature* of scrofula is well known both to the public and to the profession ; for, although the disease is not commonly connate, yet the tendency to it is, and the characteristic nature of the affection often manifests itself at an early period notwithstanding every effort to prevent its development. That a parent may develop a tendency to malnutrition, to underdevelopment of the blood, just as he may a peculiar feature or mental condition, is undoubted. It is by the hereditary transmission of peculiar constitutions and modifications of action in the organisation that hereditary diseases develop themselves at certain periods in the life of the offspring, when the injurious results of the morbid actions that have been transmitted have had time to be produced. There are certain conditions which, though not scrofulous, are supposed to have a tendency to develop this disease in the offspring to which they are transmitted ; thus very dyspeptic parents commonly have strumous children ; so also, the offspring of very old or very young people often exhibit a proneness to scrofulous affections. The influence of intermarriage is still a matter of doubt, but I believe that it exercises little influence in this respect ; and it is commonly stated that the inhabitants of small communities who intermarry closely, such as those of the Isles of Portland and of Man, are not more liable to scrofula than other individuals.

The most powerful occasioning cause of scrofula, and that which in most civilised countries is likewise the most frequent, is *malnutrition and mal-assimilation* arising from an habitual disregard of hygienic laws ; either from want of food, or the administration of improper food, in the poorer classes ; or, from overfeeding, and overstimulation of the digestive organs, amongst the children of the wealthier orders of society, inducing chronic irritation of the mucous membrane of the stomach, and interference with the digestive powers, and consequently with nutrition. The influence of food that is nutritious in quality or insufficient in quantity, has been shown by Mr. Phillips, in his excellent *Treatise on Scrofula*, to be the most immediate cause of this disease ; and when conjoined with the injurious effects of a confined and impure atmosphere, it may be considered as sufficient to occasion the disease in those cases in which no predisposition to it exists, and greatly to develop any hereditary tendency to it in the system. It is to the conjoined influence of agencies such as these, that we must attribute the prevalence of scrofula amongst the lower orders of town and rural populations.

Scrofula is often called into immediate action by the *debility induced by previous diseases*, such as measles, scarlatina, hooping-cough, &c. It usually develops itself at an *early age*, though seldom before the child has reached its second year. It is most commonly about the period of the second dentition that the affection declares itself, and it is rare to meet with it for the first time after the ages of twenty-five or thirty-five. According to Phillips, when it is fatal it usually proves so before the fifteenth year ; 60 to 70 per cent. of the deaths occurring before this age. Sex does not appear materially to influence the disease ; though, according to the same authority, the deaths of males from scrofula exceed those of females, in this country, by 24 per cent. If, however, we are to regard phthisis as an allied affection, people who are scrofulous in early life often becoming phthisical at a later period, these numbers may require correction.

TREATMENT.—This should rather consist in endeavouring to prevent the occurrence or full manifestation of scrofula, than in removing it when it is actually existing. Indeed, the preventive treatment is perhaps of most consequence, and by proper attention to it I have no hesitation in saying, that the development of the affection, even when hereditary, may be stopped ;

and the child of strumous parents, presenting perhaps the features indicative of the diathesis, may pass through life without the disease having an opportunity of declaring itself. In order to accomplish this, however, the preventive plan of treatment must be commenced early, and continued uninterruptedly for a considerable time, even for years.

The *Preventive Treatment* of scrofula may be said in general terms to consist in close and continuous attention to hygienic rules. The diet must be especially attended to; nourishing food, but of the lightest quality, being given. A great error is often committed in overloading the stomach with more or with heavier food than it can digest, under the impression that strong food is necessary to give the patient strength. In consequence of this error, the irritability of the mucous membrane is kept up, nutrition is imperfectly and badly performed, the surplus food is thrown off in the shape of lithates or other products of malassimilation, and health and strength, which are the results of perfect nutrition, become impaired rather than improved. The use of stimulants, whether wine or beer, should be very sparing, and the milder and weaker should be preferred to the heavier and stronger kinds of malt liquor; the bowels must be kept regular with the simplest aperients; the clothing should be warm, and must cover the whole of the surface; and the patient should, if possible, be kept in well-ventilated rooms. He should be allowed sufficient exercise in the open air, not carried to the point of fatigue, and should, if his circumstances will permit, have change of air from time to time, alternating a sea with an inland climate. Bathing also, whether in sea or river, with the habitual use of the tepid or cold sponge-bath, and friction of the surface with horse-hair gloves or a rough towel, so as to keep the skin in healthy action and its cutaneous circulation free, should be regularly practised.

The *Curative Treatment* should be specially directed, like the preventive, to the general improvement of the nutrition, and through it to the augmentation of the constitutional vigour of the patient; all those hygienic means that have just been alluded to being continuously carried out.

The more strictly medical treatment of scrofula consists in the administration of tonics and alteratives with the view of improving the patient's constitutional powers. Before they are administered, however, it is always necessary to see that the digestive organs are in a healthy condition. Scrofula is a consequence of malnutrition; and unless we see that digestion, the first stage of the nutritive process, is properly accomplished, all other means will be useless. When the tongue is covered with a white, thick, creamy fur, having elongated papillæ and red edges, the mucous membrane being in a state partly of irritability and partly of debility, neither purgatives nor tonics can be largely administered: the one irritating, the other overstimulating the morbidly sensitive mucous membrane. Under these circumstances the patient should be confined to the mildest possible diet, which must principally consist of milk, boiled fish, white meats, and light pudding, no stimulant of any kind being allowed except a small quantity of weak bitter beer; and, unless the patient have been accustomed to the use of stimulants, this even had better be dispensed with. Small doses of mercury with chalk, of soda and rhubarb, should be occasionally administered at bed-time, with some of the compound decoction of aloes on the following morning, and a few grains of the carbonate of soda or of potass may be given twice or thrice a day in some light bitter infusion, as of cascarrilla or calumba. In many cases of strumous disease, more especially those affecting the joints and bones, the liver will be found to be enlarged and sluggish in its action, the patient every now and then becoming bilious, sallow, and jaundiced, under

these circumstances, small doses of blue-pill, carried off with the compound decoction of aloes or a rhubarb draught, will be found necessary from time to time. When all gastric irritation has been removed in this way, or if it have not existed in the usual marked degree from the first, the patient being pale and flabby, with a weakened condition of the pulse, of the skin, and of the mucous surface, then tonics may be administered, and the more specific treatment adopted.

The great remedies which are employed with the view of removing scrofula and curing the affections it induces, are iron, iodine, the preparations of potass, and cod-liver oil. These are all extremely useful, either singly or conjoined, as they serve to carry out distinct indications in the management of this affection.

Iron is most useful in improving the nutrition of pale flabby anemic subjects, increasing markedly the quantity and quality of blood in the system. The best preparations for children are, I think, the vinum ferri and the iodide. In older persons the tincture of the sesquichloride, and some of the forms of the citrate of iron, appear to be most serviceable; in other cases, again, the natural chalybeate waters will be found to agree best.

Iodine is especially valuable in promoting the absorption of effused plastic matters, and in lessening the morbid hypertrophies which so commonly take place in scrofula. The preparation usually employed is the iodide of potassium. In order that this may produce its full effects, it should be given as freely as the patient will bear it, continued for a considerable length of time, and especially administered in combination with other preparations of potass. With the view of preventing its irritating the stomach, it should be given in a considerable quantity of some bland fluid. Its combination with the other alkalies renders it more efficacious in removing strumous enlargements and deposits of aplastic and tuberculous matter. For this purpose I have found the following form extremely useful for adults, the dose being proportionately diminished in the case of children:—R. Potassii ioduli, Potassii chloratis, aa ʒj.; Potassæ bicarbonatis, ʒiij. Divide into twelve powders, of which one is to be taken night and morning in half a pint of warm milk.

In other cases, the liquor potassæ, Brandish's alkaline solution, or lime-water given freely in milk, are serviceable; but I prefer the above prescription.

Cod-liver oil, which may be looked upon rather as an article of diet than as a medicine, is of essential utility in improving the nutrition of the body in cachectic and emaciated states of the system, more particularly in growing children, or in individuals who are suffering from the wasting effects of strumous suppuration; it not only fattens but strengthens the system, increasing decidedly the muscular power and the quantity of red corpuscles in the blood. It may often very advantageously be administered in combination with the iodides of potassium or of iron.

Of the other tonic remedies which may be employed in this affection, such as the preparations of bark and of sarsaparilla, I need say nothing beyond that they may often be usefully administered in fulfilling ordinary therapeutic indications.

The Local Treatment of scrofula consists in a great measure in the ordinary local management of chronic inflammation, modified according to the seat and particular nature of the affection. Much of the local treatment, however, especially in the more advanced stages, consists in removing the effects of the disease in the shape of aplastic deposits, false hypertrophies, and general enlargement and thickening of parts. This may usually be done by

the application of lotions containing the iodide of potassium, or the carbonate of potass, applied by means of lint covered with oiled silk; a drachm of each of the salts, with an ounce of spirits of wine to eleven ounces of water, makes an excellent application, which appears to dissolve away the fibrinous and plastic deposits so common in this disease. In many cases frictions with the iodide of lead ointment, or pressure by means of straps and bandages, will be found the most serviceable means that the surgeon can adopt. When matter forms, it should be let out in accordance with the rules laid down in treating of the more chronic forms of abscess. In these cases, the injection of the sac of the abscess with a solution of iodine will be found very useful.

OPERATIONS IN SCROFULOUS CASES.—In cases of scrofulous disease of the soft parts, the bones, or the joints, the question of the propriety of operating, whether this be for the excision of a tumour, the resection of a joint or bone, or the amputation of a limb, has often been discussed. In these cases, operations should not, I think, be undertaken too hastily, too early in the disease, or especially in very young subjects. The affection being a constitutional one, it will often be found, as the general health of the patient improves by proper treatment, that local mischief, which at first appeared of a very intractable character, gradually assumes a more circumscribed and healthy form, and, in fact, to a great extent undergoes spontaneous cure by the restoration of the healthy action in the parts. This we especially find to be the case in young children, in whom very extensive disease of the bones and joints may often be recovered from, without the necessity of any serious surgical interference. Should any operation be undertaken, it is deemed not to have recourse to it whilst the disease is actively spreading. Under these circumstances, it is not only probable that suppurative inflammation of an unhealthy kind may be set up in the wound itself, but that disease of the soft parts or bones may very likely recur in the cicatrix of the original wound, or that the corresponding parts on the opposite side of the body may become similarly affected in very chronic cases of scrofulous disease of bones and joints. I have several times observed, after excision of the elbow, the knee, or the bones of the foot and wrist, that the morbid action has returned in the contiguous soft parts to such an extent as to render a second operation necessary, although the bones were not implicated; the tissues in the neighbourhood of the cicatrix becoming swollen, spongy, and infiltrated with a quantity of gelatinous semi-transparent plastic matter, running into unhealthy suppuration, with fistulous tracts leading through it that could not be brought to heal. In some cases even of simple strumous disease of the integuments of the arm, leg, or foot, attended with great and irregular deposition of plastic matter, and chronic and intractable ulceration, amputation of the limb is the only course left to the surgeon. When strumous suppuration leads to hectic, the patient will speedily sink unless the diseased structures be removed.

CHAPTER XXXVI.

SYPHILIS.

By the "venereal disease" is meant any affection that arises from sexual intercourse. It is usually considered to include two distinct specific diseases—Syphilis and Gonorrhœa. These were supposed by Hunter and his followers to originate from one and the same poison. But this doctrine is erroneous; for not only are the local appearances and constitutional conditions induced by these affections widely different, but Ricord has shown in the most conclusive manner, that the gonorrhœal discharge, when inoculated on the skin or mucous membrane, never under any circumstances produces a chancre; and that, on the other hand, chancreous pus can never be made to give rise to a gonorrhœa; but that, in fact, each disease propagates itself, and no other. The two diseases may, however, co-exist; and those cases in which, after connection with the same woman, different men have contracted different forms of the disease, or even both affections, are in all probability to be explained by the fact, which Ricord has pointed out, that a woman may at the same time be affected by gonorrhœa and deep-seated chancres on the uterus; so that, although supposed to be labouring under only one, she may easily communicate both or either of these diseases—the true nature of her ailments being only ascertainable by examination with the speculum.

Syphilis* is a specific disease, arising from sexual intercourse, and transmissible by the contact of its own specific pus with a tender surface, by inoculation into the system through the medium of the secretions; or by hereditary taint under certain special conditions. It presents two distinct orders of symptoms, the local and the constitutional. The *Local* or *Primary* symptoms occur only on the part to which the virus is immediately applied, and are transmissible solely by direct contact or inoculation; the *Constitutional* or *Secondary* symptoms depend upon the absorption of the poison into the economy, affect consequently most of the tissues and many of the organs, and are capable of hereditary propagation, and occasionally of transmission through the secretions.

It would be altogether foreign to the scope of this work were I to enter into the question as to the origin of syphilis, a subject that admits of much dispute, and which has been keenly argued. After an attentive examination of it, I think we cannot fail to come to the conclusion that syphilis was either introduced into Europe, or originated there, towards the end of the fifteenth century; or, if it be allowed that it previously existed in the Old World in a mild or modified form, that about this time it suddenly assumed great intensity, all its symptoms being aggravated in a remarkable and fearful manner, presenting characters which have certainly not accompanied it in modern times, if we except the forms that were observed in the British armies during the Peninsular War, and, according to Larrey, among the French troops during Napoleon's German campaigns.

PRIMARY SYPHILIS. CHANCRE.

Primary or Local Syphilis is characterised by the presence of specific sore of special form and appearance, characteristic of the nature of the disease.

* Gonorrhœa will be treated of in the chapters on Diseases of the Urinary Organs.

These may occur on the cutaneous, the muco-cutaneous, and mucous surfaces most commonly on the latter, on account partly of their greater exposure to contagion, but chiefly from their being less perfectly protected by epithelium. These local specific ulcers or *Chancres* present much variety as to their appearance and to the course which they pursue: so great indeed are the varieties, that they have been looked upon by some surgeons as affording evidence of distinct diseases, proceeding from different poisons. This doctrine, however, has been shown by Hunter, and more recently by Ross, to be entirely erroneous; the variety in their appearance depending on sex, constitution, and other accidental circumstances. A chancre, then, is a specific venereal sore or ulcer, originating invariably from contagion, and capable of propagation to other parts of the same or different individual by inoculation. Like all other ulcers, a chancre presents two distinct periods: the first, in which it is either spreading or stationary, in which alone it is specific, and which may be of almost indefinite duration; and the second, in which it has commenced to granulate, and a process of repair is being set up in it.

SPECIFIC NATURE.—Ricord has made the important observation that, if the pus from a chancre, during its first period, be inoculated into any part of the surface of the body, it will invariably produce another specific syphilitic sore or chancre; and that no pus that is not chancreous can, under any circumstances, occasion the specific venereal ulcer. In this way it is always easy to test whether a suspected sore be syphilitic or not. Ricord has further shown that syphilis is always in the first instance a local disease, being confined to the specific sore; and that the constitutional symptoms are only produced by the absorption of the poison from the chancre, which is indeed a truly poisonous ulcer, from which the virus may be absorbed into and disseminated through the whole system.

ORIGIN AND PROGRESS.—Chancres are necessarily usually contracted in impure sexual intercourse with a person already contaminated by the disease, by the direct contact of the healthy with a previously diseased surface. They do not appear to originate *de novo*, but always by direct contagion. When chancres are caught in connection, they usually commence with a small excoriation, which appears to have been directly inoculated with the specific poison. In other cases, again, though more rarely, they may be seen at first in the shape of a small pointed pustule, which speedily breaks, leaving an ulcer of a specific character in its site. Very generally, however, this pustule escapes observation, and the disease is presented in the first instance as an ulcer. The chancreous ulcer, whatever form it assumes, seldom makes its appearance until a few days (five or six) after connection. In some cases, however, I have observed it, evidently from the infection of a fissure or crack, on the day following impure intercourse; and occasionally, in rare instances, it does not occur until a much later period than that which has been mentioned.

Chancres are occasionally contracted in various irregular ways. Thus they may occur on the fingers of surgeons or accoucheurs from dressing venereal sores, or from attending syphilitic women during labour; in other cases, from the contact of filthy clothes or dirty utensils with the person; and not uncommonly, it is said, they are contracted at public waterclosets. Although the latter mode of infection is not impossible, it should be received with doubt, as it is an explanation not uncommonly adopted by those who desire to account for the consequences of an act of immorality in a way that does not expose them to reproof.

Whatever be the appearances presented by a chancre, there can no longer

be any doubt that the disease arises from one kind of virus only, the modifications in the sore depending on its situation, on the constitution of the patient, and occasionally on that of the individual who communicates the infection. That this is so, is evident from the facts that every chancre, when inoculated, reverts to one typical form; and that, however much chancres may ultimately differ, they all present the same characters during their early stages. The progress of a chancre that has been artificially inoculated on any part of the cutaneous surface is as follows, and its study will serve to eliminate what takes place under other circumstances. During the first twenty-four hours after the introduction of the specific pus into the skin on the point of a lancet, we find that some inflammation is set up around the puncture, which becomes hot, red, and itchy. About the third or fourth day, a pointed pustule is produced, which is at first deep-set, but becomes on the following day more superficial, with some depression in the centre, resembling pretty closely a small-pox pustule; on close examination, this will be found not to be a true pustule, but rather a mass of epithelial scales and pus not included in a distinct wall. On the fifth day, it has become hard at the base, apparently from the infiltration of plastic matter, and on the sixth it has usually dried, forming a small round scab, and leaving an ulcer which presents the typical characters of a true chancre, being circular and depressed, with a foul greyish surface which cannot be cleansed, sharp-cut edges, a hard base, and an angry-looking red areola around it. This is the typical chancre, and these are the appearances that every true syphilitic sore on the skin will present about the fifth or sixth day after inoculation: from this time it may diverge more or less completely from these characters, but will yet, if inoculated at any time during the poisonous stage, produce an ulcer that will run the specific course up to the same period, after which it may in its turn again deviate into one or other of the special forms that chancres occasionally assume. When inoculated on a mucous surface, chancres do not so early assume an indurated character around their base.

VARIETIES.—These have been described under various denominations by the numerous writers on syphilis. The following classification will include them all -- 1, the Simple or Soft Chancre or Chancrous Excoriation; 2, the Indurated or Hunterian Chancre; 3, the Phagedenic Chancre; and 4, the Sloughing Chancre. As Mr. H. Lee has observed, each of these varieties of chancres is associated with a particular variety of inflammatory action. Thus the *soft* is the *suppurative* form; the *indurated* is the *adhesive*; the *phagedenic*, the *ulcerative*; and the *sloughing*, the *gangrenous*. The specific virus of syphilis is in each case associated with a special form of inflammation, by which its local characters are determined and its constitutional effects influenced.

1. *Simple or Soft Chancre, or Chancrous Excoriation*, is certainly that form of the disease which is most commonly met with in London at present. It is of an excessively contagious character, often being contracted by mere contact without penetration. It consists of one or more small sores, of a very shallow character, resembling rather an abrasion, with sharp-cut edges, somewhat circular in shape, and having a tawny greyish or yellowish surface, with a narrow red areola around the edge: in many cases attended with much heat and itching. These sores are usually seated on the clift under the corona glandis, or about the glans, the whole of which may be involved by them. In fact, one peculiarity of this chancre is its tendency to multiplication on the contiguous structures. In other cases, the sores invade the frænum, which may be perforated; or they may occupy the mucous surface of the prepuce. In no cases are they indurated.

These excoriated chancres not unfrequently present somewhat varied appearances. In some cases their surface becomes covered with large fungous granulations, hence termed *fungating sores*. In other instances they are truly irritable, becoming exceedingly sensitive, with a tendency to spread, and having an areola of a dusky-red hue around them. It very frequently happens that these chancres are attended by much general inflammation of the penis; the organ being swollen, red, and semi-transparent, from subcutaneous oedema, and usually in a state of phimosis, with a good deal of purulent secretion between the prepuce and glans.

2. The *Indurated or True Hunterian Chancre*, as it is termed, is not by any means so frequently met with as the last-described variety, it may, however, be looked upon as the typical form of chancre, resembling in every respect the inoculated form of the disease. The great characteristic of this form of chancre is the induration of its edges and base; and this character is met with from the very first. Any chancre, but more especially the circumscribed excoriation, may during its progress become indurated from undue stimulation, or from being otherwise improperly inflamed; but the Hunterian chancre is indurated from the very first, and continues so throughout. This induration of the base is the result of a peculiar plastic effusion, which, though it microscopically and chemically resemble ordinary healthy lymph, yet very distinctly differs from it in its vital characters, just as the pus of a chancre may differ in this respect from that which is secreted by a healthy ulcer. The great peculiarity of the plastic base of the Hunterian chancre is certainly that it in some way serves as a source for the continued production of the virus, and the consequent impregnation of the system with it. Besides the presence of this induration, the Hunterian chancre is characterised by its circular shape, its elevation above the surrounding parts, and the very adherent grey slough that covers its surface. It is usually seated on the glans, but not unfrequently on the skin of the prepuce or of the root of the penis. In this form of chancre there is a special almost invariable tendency to enlargement of the lymphatic glands in the groin.

3. *Phagedænic Chancre* is characterised by a tendency to erosion, with much destruction of the parts that it invades. It may assume the phagedænic character from the very first, or this may be set up in one of the other varieties of chancre at some period of their course. The progress of this phagedænic or eroding chancre is usually somewhat slow, but continuous; it commonly affects the glans, more especially in the neighbourhood of the frenum or urethra, destroying a considerable portion of the organ in this situation. Mr. Wallace has divided this form of chancre into three varieties, that *without slough*, that *with white slough*, and that *with the black slough*. Each of these varieties, again, may be of a *simple*, an *uninflamed*, or an *irritable* character. This classification appears to me to be an useful and practical one, and I accordingly adopt it.

The *phagedænic chancre without slough* is a truly eroding ulcer, spreading with sharp-cut edges, attended by some slight inflammatory action, and with much activity of progress; it is commonly observed about the frenum and underpart of the glans, and very frequently hollows out and destroys the organ in this situation to a considerable extent.

In the *phagedænic chancre with white slough*, we find an irregular eroding ulcer, with a thin margin of white slough situated at the junction of the dead and living structures; that which covers the surface of the sore having usually become darkened by exposure to air, to dressings, and to secretions.

The *phagedænic chancre with black slough* differs but little from the last, except in the colour of the slough, which may be in a great measure ac-

dental, and in its tendency to induration, and to somewhat rapid extension; it must not be confounded with the next form of chancre, which presents many points of difference. All these varieties of phagedenic chancre may be inflamed, being attended by much heat, redness, and swelling, increase of discharge, and rapidity of action; or they may be irritable, occurring in cachectic individuals, when they are accompanied by much pain, and usually a good deal of constitutional disturbance of a nervous and irritative type.

4. *Sloughing Chancre, or Gangrenous Phagedæna*, is a combination of rapidly spreading and destructive gangrene with the syphilitic poison, and may be looked upon as a gangrenous inflammation of a syphilitic sore. One peculiarity of this form of chancre is, that the sloughing action often destroys the specific character of the disease as efficiently as if it had been touched with the actual canterbury. Hence it is very often not followed by any constitutional symptoms.

The gangrenous action is usually the consequence of the confinement of the syphilitic pus under an elongated prepuce, in a person of inflammatory and irritable constitution, in whom the loose cellular structures of the genital organs readily take on sloughing action when inflamed. It usually affects the upper surface of the prepuce; the parts becoming immensely swollen, red, and somewhat brawny, and the prepuce being in a state of complete and permanent phimosis, a dusky black-looking spot soon makes its appearance on one side of the organ; this rapidly extends, giving rise to thick, black, soft, and pultaceous sloughs, destroying perhaps the whole of the prepuce, and exposing and implicating the glans to a great extent, accompanied sometimes by copious hemorrhage from the dorsal artery of the penis on the separation of the sloughs, and by denudation of the corpora cavernosa. In other cases, the prepuce sloughs on one side only; a round aperture forming in it, through which the glans projects, whilst the swollen and inflamed extremity of the prepuce hangs down behind it, giving the organ a very remarkable and, at first sight, somewhat puzzling appearance. After the separation of the sloughs, granulations rapidly spring up, the sore loses its specific character, and cicatrization advances with rapidity.

SITUATION.—As chancres almost invariably result from connection with persons labouring under primary syphilitic disease, they commonly occur on the genital organs. In the male they may be met with in any part of these; their characters varying somewhat, however, according to the situation in which they occur. They are by far most commonly seated in the angle formed between the glans and the prepuce; they then appear most frequently at the orifice or on the inner surface of the prepuce, next on the frenum, then on the glans, and lastly at the orifice of the urethra, or on the skin of the body of the penis. When occurring in these unusual situations, they are invariably indurated. Those about the frenum are often sloughy and irritable, have a great tendency to perforate or destroy this fold of mucous membrane, and are more frequently followed by hemorrhage or bubo than any of the other varieties of the disease.

Urethral Chancre is usually situated just within the orifice of the canal, and may be seen on pressing open its lips, in the form of a small sloughy sore, which occasionally creeps out upon the glans. Sometimes it is more deeply seated, so as to be out of sight; when this is the case, a thick, mucous, sloughy, and bloody discharge appears in small quantities from the urethra; at a little distance up the canal there will usually be felt, on grasping the organ between the fingers, a circumscribed indurated spot, which is somewhat painful on pressure and after micturition. The chancres have been found by Ricord to extend along the whole of the urethra, even

to the bladder; and it is their presence in this canal that formerly led to the supposition of the identity of syphilis and gonorrhoea, an error the nature of which has been cleared up by the test of inoculation; the discharge from urethral chancre producing the typical sore, that from gonorrhoea giving no result when introduced under the skin. The existence of chancre within the urethra may be suspected if the surgeon observe that the urethral discharge is small in quantity, and somewhat dark-coloured, ichorous, and sloughy-looking. The chancre may be detected by evertng the edges of the urethra, or, if situated too high up the canal to be seen, by being felt hard and nodulated through its coats.

Chancre in the Fingers not unfrequently occurs amongst surgeons and accoucheurs as a consequence of inoculation during the dressing of a venereal sore, or the delivery of a diseased woman; and is also occasionally met with among non-professional people. It usually occurs as a small sore by the side of the nail, and under its matrix, with much swelling, redness and pain in the finger, which becomes bulbous; pain and swelling of the axillary glands soon follow. If the nature of the disease be not recognised, the ulceration will creep round the tip of the finger, have a foul and sloughy look, with exquisite tenderness, and, resisting all ordinary treatment, may be set down as malignant; on which supposition the amputation of the finger may be proposed and practised. I have seen at least four cases in which this extreme measure has been proposed, but in which a timely discovery of the true nature of the affection caused the finger to be saved.

In some cases of disgusting depravity, chancres are met with at the *Mouth of the Anus*, and on the *Lips and Tongue*. These are always indurated, and from their foul surface, hard base, and persistent character, may readily be mistaken for cancerous affections. The test of inoculation will always decide this point.

Chancres may also form on other parts where they have been accidentally or purposely inoculated. Thus I saw many years ago (1859), in Ross's wards, a man labouring under *eczema of the legs*, in whom the cutaneous disease had been converted into a series of immense chancres by accidental inoculation from a sore on the penis.

In *women*, chancres are usually situated on the external organs of generation, most usually just inside the fourchette or labia minora, very rarely indeed on the lining membrane of the vagina, but sometimes on the cervix or os uteri; hence it is impossible ever to pronounce a woman free from syphilis without examining these parts by means of the speculum. When situated upon the external organs, they are not unfrequently concealed between the rugæ, or in nooks and corners of the mucous membrane. In these cases, their presence may sometimes be detected by the labia being swollen and oedematous from the irritation of the chancres.

Diagnosis.—The diagnosis of chancre is usually sufficiently easy, the peculiar character of the sore enabling the surgeon to recognise it in all its forms. In other instances, however, it is by no means easy to say positively whether an ulcer on the penis be or be not of a chancreous character. It is especially difficult to distinguish some forms of excoriated chancre from herpes or aphthæ on the prepuce or glans, or from those slight excoriations that many men habitually contract after a somewhat impure connection, so also, the wound resulting from a ruptured frenum often presents a suspicious appearance. In these cases, however, the absence of any specific character about the sore, its immediate occurrence after connection, the general known tendency of the patient to these affections, and the fact of the inguinal glands not being indurated and enlarged, as they are in cases of true chancre,

will enable the surgeon to make the diagnosis. When the prepuce is in a state of inflammatory phimosis, it is always extremely difficult to determine by mere examination whether there be chancres under it or not, though their indurated bases may sometimes be felt through it. In the case of the indurated, the phagedenic, or the sloughy chancres, there can be little difficulty in establishing the true nature of the affection. In those cases in which a comparison of the characters of the sore with one or other of the different recognised varieties of chancre failed in enabling the surgeon to determine the true nature of the affection, it was thought at one time that the influence exercised by mercury upon the sore would determine whether the disease was syphilitic or not—the true chancres being supposed to be curable in no other way than by the internal administration of mercury; but although there can be no doubt that the influence exercised by treatment assists the surgeon considerably in the diagnosis of obscure cases, yet it cannot be relied upon as a test of the nature of the disease, many syphilitic affections being readily curable by very simple means without mercury. The only sure and unerring test that we possess of the nature of a suspicious sore, is the result of the inoculation of its pus into some part of the surface of the body. If this be done with the point of a lancet into the inside of the thigh, the typical chancre will be produced if the suspected sore be syphilitic, and no effect will result if it be not so. It must be borne in mind, however, that if the ulcer from which the pus is taken have reached a granulating state, no effect may be produced, whatever its previous condition may have been; and that if the sore, though of venereal origin, be not a primary syphilitic one, its pus will not be inoculable. Though inoculation is a sure and valuable test of primary syphilis, it should not be too freely had recourse to; for it not uncommonly happens, as I have several times seen, that the sore produced by it is far more troublesome in healing than the original chancre.

When chancres are situated upon parts of the body where they are not ordinarily encountered, as at the tips of the fingers of surgeons or accoucheurs, or in those disgusting cases occasionally met with in hospital practice in which they are seen on the lip or tongue of prostitutes or even of men, the diagnosis is often obscure and difficult. Here, however, the circular, foul, and sloughy character of the sore, the extent of the surrounding inflammation, the speedy induration and enlargement of the neighbouring lymphatic glands, and the rebellious character of the disease, will indicate its true nature.

TREATMENT OF PRIMARY SYPHILIS.—The treatment of syphilis is a subject that has engaged the anxious attention of the most eminent surgeons, and is one on which so much difference of opinion and practice still prevails, that I shall not endeavour to discuss the subject generally, but rather confine my remarks upon it to the consideration of that form of treatment which has met with the sanction of the best surgeons in this country, and which a considerably extensive experience in hospital and private practice has led me to consider as the most safe and effectual.

The treatment of chancre is of a *local* and of a *constitutional* character; the local treatment having for its object either to destroy the poisonous character of the sore, or to modify it so as to bring it into the state of a healthy ulcer; the constitutional treatment is not only intended to facilitate this, but to prevent, if possible, infection of the general system with the poison.

Local Treatment.—This has for its object either the destruction or the modification of the specific character of the sore. The complete destruction of the local virus should always, if possible, be effected; and if this can be

done in the early stage of the disease (according to Ricord before the fifth day after inoculation), there will not have been time for any constitutional infection to have taken place from the absorption of the poison into the system. But even though this time have been considerably passed before a surgeon sees the sore, it is well to destroy the ulcerating and poisonous surface, from which continued absorption must necessarily be going on. This should be effected by the application of caustics in a sufficiently concentrated form to destroy radically and at once the specific character of the sore, so as not only to save the pain, but to prevent the irritation attendant upon frequent applications. The nitrate of silver which is commonly used for this purpose is too weak to secure the effect it is intended to accomplish, being apt to irritate and inflame, and not to destroy the chancreous surface, thus necessitating repeated and painful applications. I consequently prefer to this the strong nitric acid, one application of which will very commonly suffice to annihilate the specific character of the sore: though more energetic in action, it does not give rise to more pain than the nitrate of silver. It should be applied by means of a piece of wood, a glass rod, or a small dandelion of lint wrapped round the end of a silver probe: with this the sore may be freely mopped, and then, a stream of cold water having been poured over it to wash away any superfluous acid, a light poultice or a piece of water dressing should be laid on; after the small slough produced by the caustic has separated, a healthy granulating surface will be left. The caustic may be applied at any time during the continuance of the specific condition of the sore; but when once this has been destroyed, it should not be re-applied. The potassa fusa and the potassa cum calce, though occasionally used, are far less manageable and not more efficacious applications than the nitric acid.

These are the means that are generally most useful in *Simple Chancre*. In some cases, however, inflammation of the sore, or peculiarities in its situation, demand modifications of the treatment.

If there be much inflammation about the sore and prepuce, this must first be subdued by the application of cold poultices, or of lead and opium lotion. When this is removed, if the sore have not lost its specific character, the caustic should be applied as usual.

When the chancres are situated around the margin of a tight prepuce, assuming the form of vertical cracks or fissures, they should be well everted by drawing the integument back, and then cauterised in the usual way.

Should there be phimosis with discharge of chancreous pus from under the tightened prepuce, it will be better to slit this up, so as to expose and freely cauterise the subjacent chancres. If the cut edges of the prepuce become inoculated, they must also be cauterised freely and early.

If the chancres be situated round the orifice of an elongated and tight prepuce, circumcision is the best means of removing the disease and the inconvenience at the same time. The cut surface, however, will always become infected, and require to be freely cauterised with nitric acid.

After the slough produced by the caustic has separated, the surface may begin to granulate healthily at once, requiring but simple dressings; but in the majority of cases it will continue in a somewhat unhealthy condition, requiring special topical applications to cause it to cicatrise soundly. If it be weak and fungating, an astringent lotion, such as the following, will be found most useful:—*R* Tanum, ℥j.; Tinct. lavandulæ comp., ʒij.; Vin. rubri, ʒiv. *Ft. lotio.* Or a solution of sulphate of copper may be applied, and the sore touched from time to time with the nitrate of

silver. If there be induration at its base, the black or the yellow wash will perhaps be found the best application that can be used.

In the *Indurated Chancre* no attempt should be made to burn away the indurated base with caustics, as it will prove unsuccessful, the indurated condition always extending beyond the influence of the caustic. In these cases, the best local application is generally the black wash.

In the *Phagedenic Chancre* a different management is required ; if there be much irritability about the sore, the nitric acid cannot be borne ; and here the best application is an opiate lotion, conjoined perhaps with small quantities of the chloride of soda. If the part require more stimulation, a few drops of the dilute nitric acid may advantageously be added instead of the chloride. In these cases, however, the application of the strong nitric acid may often be required at a later period of the affection, on the removal of the local irritation by the topical employment of sedatives. In many cases, again, the local inflammatory action is best removed at first by the application of the concentrated nitric acid, this being followed by opiate lotions or emollient poultices, and the caustic being re-applied whenever there is a tendency to the extension of the disease.

In *Sloughing Chancres*, when the prepuce is greatly tumefied, in a state of inflammatory phlogosis, and of a deep-red or purplish colour, with threatening of extensive gangrenous action, a director should be passed between it and the glans penis, and the swollen prepuce slit up. In this way tension is removed, and the extension of the sloughing action arrested. Any chancre that is exposed must then be freely touched with nitric acid. Should the parts already have fallen into a state of gangrene, emollient and antiseptic applications will generally be found to agree best : yeast, carrot, opiate, charcoal, or chlorinated poultices should be employed, the sloughs removed, and any parts that are partially destroyed by the gangrenous action, as portions of the prepuce, slit up, so as to remove tension and lessen inflammation. In cases of inflammatory sloughing of the penis, the hemorrhage, that occasionally results from some of the bloodvessels of the organ being opened by this action, may, if moderate, be looked upon as highly beneficial, inasmuch as it is often followed by an arrest of the morbid process. If, however, it occur to an alarming extent, the patient should be put under calomel and the actual cautery freely applied. This not only stops the bleeding, but arrests the progress of the sloughing action. When once the chancre is healthily granulating, it must be dressed in the same way as any common ulcer.

In using lotions to any form of chancre, care should always be taken to keep a piece of lint soaked in the fluid constantly applied between the prepuce and the glans, and, in women, between the opposite labia ; for, unless this be done, the contact of the diseased and inflamed mucous surfaces with one another will tend to keep up irritation and morbid action.

Constitutional Treatment of Primary Syphilis.—This is of the first importance, not so much with a view of inducing the local sore to cicatrise, as of preventing, if possible, constitutional infection. As it is impossible to say when the absorption of the poison into the system takes place—though it is probable, as Ricord supposes, that it does not occur before the fifth day—resources should be had to constitutional treatment from the very commencement of the disease.

Mercurial and Non-Mercurial Plans of Treatment.—The constitutional treatment of primary syphilis has undergone various changes, according to the prevailing doctrine of the day. It had been decided by the surgeons of the last and of the early part of this century, that mercury

acted as a specific against the syphilitic poison. This doctrine was firmly established, that Hunter, and many of the great surgeons of his school, looked on the curability of a sore without mercury as a proof that it was not syphilitic. About the commencement of this century, however, it was found by the observations of the army-surgeons, amongst whom Mr. Rose took a principal share in the inquiry, that the different forms of primary syphilis were curable without the necessity of administering mercury, or indeed of having recourse to any specific treatment whatever. These observations, which appear to have been founded on what was witnessed in Spain and Portugal during the Peninsular War, led to the introduction of an important modification in the treatment of syphilis, viz. the *non-mercurial* or *simple* plan, as it is termed: a mode of practice that obtained great favour, and has been extensively tried. Of late years, however, a reaction has, I think, taken place in the minds of most professional men; and mercury is again employed in the treatment of the disease, but more moderately and scientifically, and consequently more successfully than before.

The arguments in favour of the non-mercurial plan of treatment are briefly these: that by this system of treatment the constitution of the patient is saved the introduction of a mineral which in many cases acts injuriously, and which, as the disease can be cured without it, may at all events be looked upon as unnecessary; that secondary affections less frequently follow this plan than they do the administration of mercury; and, lastly, that these distressing cases of constitutional syphilis which are common after mercurial courses, and which are said to depend upon a peculiar combination of the syphilitic poison and the mineral in the system, are never met with in persons who have undergone the simple treatment. These arguments, however, on closer examination and further experience, have not been proved to be quite so conclusive as the supporters of the simple treatment appear to believe. That a great number, perhaps the majority, of cases of simple soft chancre can be healed without the administration of mercury is undoubtedly the fact; but in many instances it is equally true that the primary sore, especially when indurated, does not cicatrise properly unless the mineral be administered, or, if it do close, that it heals in an imperfect manner, readily breaking out again. But it is a most serious error to confound the healing of the chancre with the cure of the disease. The cicatrisation of the ulcer and the prevention or neutralisation of the constitutional infection are two distinct things; and the test of the relative value of these two plans of treatment must depend rather on the relative frequency with which they are followed by constitutional symptoms, and on the character that these assume under one or other of these methods, than on the mere skinning over of the ulcer. I cannot agree with the statement that secondary symptoms are less frequent after the simple than after the mercurial treatment of syphilis. I have seen the non-mercurial plan of treatment very extensively employed at University College Hospital; indeed, it was formerly almost invariably practised there, more particularly in the syphilitic cases occurring among the out-patients under the late Mr. Morton, who strongly advocated it; and I have had repeated occasion to observe the frequency with which it was followed by secondary symptoms. In private practice also I have had considerable opportunities of comparing the two methods; and I can safely say that I have seen the simple treatment more frequently followed by secondary symptoms, than the mercurial plan has been when properly and judiciously employed. The supporters of the non-mercurial treatment, when obliged

to admit the great frequency with which it is followed by secondary symptoms, argue that, if more frequent, they are less severe after the simple than after the mercurial plan; and they state somewhat dogmatically, and it appears to me without much evidence to support their statement, that mercury and syphilis together form a sort of poisonous compound in the system, which produces the worst and most destructive forms of constitutional syphilis. I deny entirely, however, that we have any proof of the existence of such a combination as that which is supposed to be produced by syphilis and mercury; no evidence with which I am acquainted has ever been adduced in support of the formation of such a poison in the system. It is doubtless true that, after an ill-regulated mercurial course, constitutional syphilis of a very severe character may occasionally appear; but this seems to me to be rather owing to mercury having been improperly administered in constitutions that will not bear it, and in which, by the induction of a cachectic and depraved condition of the system, it favours the occurrence of some of the more severe forms of secondary syphilis, in the same way that any other lowering plan of treatment, or simple debility, might occasion them, but without the exercise of any specifically injurious influence. Some of the worst forms of constitutional syphilis that I have of late seen, occurred in patients to whom no mercury had been administered, but in whom the syphilitic virus had been allowed to exercise its influence unchecked, save by the so-called simple treatment. I have seen the body covered by immense ecchymatous crusts and sores in one case, rupial ulcers with destruction of the nose and palate in another, the worst kind of syphilitic cachexy with the tuberculo-pustular syphiloid in a third, and extensive disease of the cranial bones and the clavicle in a fourth; in none of which had any mercury been administered.

But though I cannot admit that the supporters of the simple or non-mercurial treatment of syphilis have brought forward any proof of its superiority over the mercurial plan, and though my own experience has taught me that secondary symptoms occur after it with equal severity, and with far greater frequency, than they do when mercury is carefully and judiciously administered, yet I am quite ready to allow that there are certain forms of primary sore, especially those of a phagedenic or sloughing kind, in which the simple treatment alone is admissible, the state of the constitution or the disease being such that mercury cannot be given in any form. In these cases the patient must be kept in bed, his bowels properly regulated, and such a treatment adopted, in accordance with ordinary medical principles, as will tend to subdue local action and improve his general condition. It is, indeed, especially in individuals of an unhealthy or strumous habit of body, or in those who are suffering from local visceral diseases of some kind, and who are not affected by an indurated chancre, that this plan of treatment should be adopted. So also in those who, from the nature of their occupations, are subjected to much exposure to wet and cold, a mercurial course cannot be properly or safely administered, and the simple treatment is the only plan that should be adopted. But even in such individuals, if the chancre be an indurated one, mercury is absolutely necessary. In all other cases I am certainly of opinion that mercury ought to be administered; and this opinion appears to be entertained by the most experienced surgeons of the day in this country and in France.

The first question in connection with the employment of mercury in syphilis, has reference to the principle on which this remedy is administered. Whether mercury exercises a specific action over the venereal poison or not, has been much discussed, and is difficult of proof. I am certainly of opinion

that it does act as a specific in cases of primary syphilis, but that this specific action is much influenced by the condition of the system, the habits of the patient, and the mode of administration of the remedy; these considerations under certain circumstances tending to counteract or otherwise to interfere with its operation. As has already been stated, I do not for a moment doubt that most primary sores may be readily made to cicatrize without administering a grain of mercury to the patient; but I believe that in these cases (and my belief is founded on tolerably extensive experience at the hospital to which I am attached), secondary symptoms will be almost certain to occur, and indeed will appear pretty soon after the cicatrization of the local sore—the disease, in fact, appearing to contaminate the system unchecked. That mercury in many cases is antagonistic to the syphilitic poison, appears evident from the fact that in some instances chancres will not heal unless it be given internally; from its influence in speedily curing infantile syphilis and preventing after-manifestations in the system, and from the fact that, when properly administered in *healthy constitutions* it may almost to a certainty be looked upon as a preventive to the occurrence of constitutional syphilis. When it fails, as it doubtless does in many cases, to prevent the constitutional infection, or to eradicate this if it have appeared, the non success may usually be traced either to want of care in the administration of the medicine, or to the existence of an impaired state of the patient's health.

In connection with the administration of mercury in syphilis, therefore, various questions present themselves, the proper determination of which is of the first importance. These have reference to the State of the Patient's Constitution, the Condition of the Sore, and the Mode of Administration of the Remedy.

The *State of the Patient's Constitution* influences materially the propriety of the administration of mercury. In ordinarily healthy constitutions it may always be safely employed; but if the powers of the system be broken by excesses of any kind, if the patient be of a strumous habit of body, if he be irritable, feverish, or excited, it must be exhibited with great caution, or should be withheld until these states of the system are modified or removed. It is especially by administering mercury to strumous and cachectic patients, or to those whose powers have been broken by habitual dissipation, that so much mischief results; and that it occasionally gives rise, by acting as a depressing agent, to local sloughing, or to some of the low forms of secondary syphilis.

The *Condition of the Sore* in which mercury should be given is equally important as that of the health. It should not be administered during the early stage of an inflamed, irritable, or sloughing ulcer. So long, indeed, as such a condition keeps up in the sore, mercury will often act injuriously, by exciting a sloughing tendency in it, more especially in debilitated or broken constitutions; hence it is well to subdue the inflammation or local urticulate condition before the mineral is employed. Many surgeons, following Ricord and Aeton, do not employ mercury in the *soft chancre*, but restrict its administration to that with an indurated base. That *soft chancres* may readily be healed without the administration of mercury, there can be no doubt; and that this mineral may in some cases be safely dispensed with, when the state of the patient's constitution or the nature of his occupation is unfavourable to its administration, there can also be no doubt. But under favourable circumstances of health or occupation, I cannot but think that even in these cases it is safer, so far as after-consequences are concerned, to give it. In all cases of indurated chancre, mercury is indispensably requisite, when

ever the state of the patient's general health or occupation may be. If it be not given, constitutional infection of the most severe form must inevitably ensue.

Mode of Administering Mercury—The particular preparation of mercury to be given, the length of time during which it should be continued, and the rules to be observed during the mercurial course, are all matters that influence greatly the result of the treatment.

Mercury may be administered in three ways : by the mouth, by inunction, or by fumigation. When it is to be given by the mouth in primary syphilis, and when it is desirable to produce but a moderate effect upon the system, I prefer the iodide of mercury, in doses of one grain three times a day ; or the Plummer's pill, in five-grain doses twice or three times a day, will be found extremely useful when the constitution is somewhat irritable. If it be desirable to produce a rapid effect upon the system, five grains of blue pill may be given night and morning. The other preparations of mercury are not, I think, required in the primary form of the disease. When it is required to produce a moderate effect, especially in somewhat delicate persons, without irritating the system or inducing much salivation, the iodide is certainly to be preferred to all other preparations.

In some cases the bowels are so irritable that the administration of mercury by the mouth invariably purges the patient ; under these circumstances the mercurial inunction may be conveniently practised. This is best done by rubbing a drachm of the strong ointment into the inside of each thigh for ten minutes every night and morning ; or by putting a similar quantity upon a piece of lint, and letting the patient wear it during the day and night in each axilla.

The duration of the mercurial course must depend upon the effect produced upon the sore ; it need not be continued until this has cicatrised, but it should be persevered in until all specific action in it has ceased, and it has acquired a healthy and healing state. This impression is seldom produced upon the sore without a slight effect upon the mouth having previously been induced, the gums becoming spongy, red, and swollen, and an increased flow of saliva taking place. It is never necessary to continue the mercury so long, or to give it to so great an extent, as to produce very profuse salivation. It was in attempting to do this, and by administering the remedy in too large a quantity and too rapidly, that the older surgeons produced such injurious consequences. The effect produced upon the sore, rather than that upon the gums, should be our guide as to the proper time for discontinuing the mercurial.

The rules to be observed during a course of mercury exercise considerable influence upon the effects produced by it. The system should always be prepared for its administration by a free purge. Whilst it is being given, the patient should, if possible, be kept in bed, or at all events be confined to the house, taking as much rest as possible ; the diet should be moderate and unstimulating, and the dress be as warm as the season will admit. If the mercury be given by the mouth, and gripe, it will be found useful to combine it with casticum. If it purge, small doses of opium may advantageously be administered in conjunction with it. After it has been carried to the full extent deemed advisable, it should not be suddenly left off, but gradually discontinued by diminishing the quantity daily during a week or ten days. If it be given in accordance with these rules, and in proper constitutions, we shall seldom find any of those injurious effects produced that were formerly described as resulting from the exhibition of this mineral ; those severe and extensive forms of ulceration of the mouth leading to necrosis of

the jaws, and the mercurial erythema, or erethismus, described by the surgeons, are now happily almost matters of history, being but evils ever met with.

Treatment of Special Forms of Chancre.—The above are the general principles upon which primary syphilis requires to be constitutionally treated; the special management of the different forms of chancre now requires a few words.

The *Simple, Soft, or Excoriated Chancre* should be cauterised with pure acid, dressed with water-dressing for two or three days until the scum separates, and then with the black wash, or the sulphate of copper, or tannin and wine lotion if the sore be weak and fungating; in which operation also it will require the occasional application of the nitrate of silver. This sore will readily heal under the non-mercurial treatment; but, contrary to the opinion of many surgeons of the present day, I consider it much safer to put the patient upon a mild course of the iodide of mercury.

It is in the *Indurated or Hunterian Chancre* that mercury is especially useful, and is indeed most imperatively required; a full and continued course should be administered, and the influence of the mineral kept up until all hardness has disappeared; unless this be done, the patient will almost certainly suffer early and severely from secondary symptoms.

The constitutional treatment of *Phagedænic Chancre* must usually be of the non-mercurial kind; indeed, it is the indiscriminate use of mercury in these cases that has, I believe, brought so much discredit upon this remedy in syphilis. The constitutional treatment of phagedænic chancre must be directed by general medical principles; rest in bed, a mild diet, the administration of salines and opiates, in those cases in which there is inflammation and irritation conjoined; whilst in those in which there is a debilitated or cachectic condition, tonics, such as bark or iron, with good food and stimulants, may be required, together with opiates to allay pain and to procure rest. The preparations of iron, especially the ammonio-citrate and potassium-tartrate, either alone or in combination with sarsaparilla, are especially useful in these cases. Although mercury is not generally admissible in phagedænic chancre, yet in that form which is characterised by a white slough, it has been found useful by Mr. Wallace; and the utility of this practice I can confirm, having found it of service in some of the more relations varieties of this disease: the mineral must, however, be very cautiously administered, and in but small doses.

In the *Gangrenous or Sloughing Chancre*, the constitutional powers of the patient will be found to be broken, and his general health depressed, so that depletory measures are seldom if ever required. The prepuce should be slit up, and free incisions should be made through the sloughing textures, so as to take down all tension; and as the fever subsides, or from the first if there be much asthenia, ammonia and bark, good nourishment, and abundant stimulants will be required; eventually the patient's strength may be supported by iron and quinine, and the irritability of the system allayed by the free administration of opium; the strong nitric acid should then be mopped freely over the parts, and afterwards charcoal or yeast poultices applied until the sloughs have separated. After the separation of the sloughs, the sore will usually present a clean appearance, the granulations cicatrising rapidly. It often happens that when a portion only of the prepuce has been destroyed, the upper part being perforated, and the preputial orifice with the underpart hanging down under the glans, the part thus projecting may be snipped off with advantage, and the organ thus moulded into a better shape.

Chancres situated within the urethra, on the fingers, lips, tongue, or other parts of the surface of the body, require a full mercurial course, being specially apt to be followed by constitutional symptoms.

After a chancre has been healed in one or other of these ways, we must endeavour to prevent the manifestation of constitutional syphilis, by the general improvement of the patient's health. This is usually best done by putting him on a course of sarsaparilla with the mineral acids, and by scrupulous attention for some months to his habits of life. The syphilitic poison may linger for a great length of time in the system, not declaring itself by any overt manifestations so long as the health continues good, but, if the patient fall into a debilitated state, even though some years have elapsed, showing itself by some of its local effects.

CONSECUTIVE SYMPTOMS.

The primary symptoms of syphilis are not unfrequently followed by a series of affections which may be termed *consecutive*, depending as they do upon the primary disease, but being local in their character, and presenting no evidence of constitutional infection. These consecutive symptoms are three in number: viz., Induration of the Chancreous Cicatrix, Bubo, and Warts.

INDURATED CICATRICES.—Most excoriated chancres are healed without any cicatrix or other trace of them being left; but in the indurated, the phagedenic, and the sloughing chancres, there is always loss of substance, often to a considerable extent, and consequently a depressed scar. In some cases, however, of excoriated and Hunterian chancre, but most frequently, I think, in the excoriated chancre, an imperfect cicatrization takes place over the surface of the sore, the specific character of which has not been destroyed; the consequence of this is that the tissue of the cicatrix gradually increases in size, becomes indurated, and is capable of infecting the system. These *indurated cicatrices* are especially apt to follow slight syphilitic excoriations, which have skinned over spontaneously, even without the patient having been aware of their existence, or which have cicatrised under simple treatment. Under these circumstances, a patient labouring under constitutional syphilis will apply to a surgeon, and, on being questioned, may deny having had any primary disease; but on examination an indurated cicatrix will be found, evidently the result of a chancre that has not been properly attended to.

Characters.—These indurations vary in size from that of a pea to that of a chestnut; they are usually situated on the mucous surface of the prepuce or glans, and sometimes on the frenum, and there is commonly an enlarged and indurated condition of the inguinal glands. The indurated cicatrix is a condition of importance, as it shows the persistence of the syphilitic poison in the site of the chancre, where it exists as a continued source of infection to the system, which it may poison as effectually and as quickly as an open chancre; a kind of zymotic action being continued in it, generating and transmitting the syphilitic ferment into the blood. These indurations must be looked upon as infallibly leading to constitutional syphilis, unless speedily removed. If left to themselves, they readily break into secondary ulcerations, forming excavated and sloughy sores. On examining their structure, it is found to be composed simply of plastic matter, consisting of the ordinary filaments of skin, with spindle-shaped and elongated cells undergoing transformation into fibro-cellular tissue. It is a remarkable fact, that the indurated cicatrix not only always comes on slowly after the sore has apparently healed, but very frequently does not make its appearance until after a lapse of some weeks or months, without inflammation, pain, or

local inconvenience of any kind—the surgeon often discovering it without its having attracted the patient's attention. In cases of indurated syphilitic cicatrix, it will generally be found, just as in the indurated chancre, that one or more of the absorbent glands in the groin are enlarged and hardened. But, unlike what happens in the case of the open chancre, these glands rarely suppurate when their enlargement depends on the cicatricial induration; in fact, it would appear as if the same structural change had taken place in them as in the prepuce or glans occasioning the original induration.

The *Treatment* of indurated cicatrix must be conducted in the same way as that of a Hunterian chancre, by means of a full and steady course of mercury, until it has wholly disappeared. Unless this be done, there is no safety for the patient from constitutional syphilis. Caustics should never be applied to the induration, as they occasion troublesome ulcers; and the only local treatment that is likely to be of any service is the application of a piece of lint soaked in black wash, so as to prevent excretion.

Bubo.—By bubo is meant a specific and venereal enlargement of the lymphatic glands that lie between the chancre and the centre of the system. A bubo, though generally produced in the groin by absorption of syphilitic virus from chancres in the penis, may occur elsewhere; as, for instance, in the axilla, in cases of chancre on the finger; in the submaxillary region, if the primary disease occur on the lip. Every enlargement of the inguinal or other lymphatic glands that occurs in a case of syphilis must not be considered a bubo. The glands may be irritated by concomitant inflammatory action about the penis, as when balanitis or phimosis are present; or they may be enlarged from the simple excitement of the parts, especially in strumous and debilitated subjects. In these cases the bubo is termed *Sympathetic*, and the affection must be considered as a simple irritation and inflammation of the inguinal glands, which may speedily subside under proper antiphlogistic treatment of a mild kind; although in many cases suppuration eventually takes place, constituting in fact a simple glandular abscess, presenting nothing in any way specific. Indeed, it scarcely ever happens that a chancre has existed for some days without the lymphatic glands in the groin becoming enlarged and somewhat indurated, especially those that lie parallel to Poupart's ligament, their enlargement being attended with a degree of stiffness and dragging pain. The liability to this irritation and inflammation of the glands in the groin is greatly increased by the patient walking about or otherwise exerting himself. But I do not think that causes such as these influence the occurrence of the true specific bubo, which appears to originate from direct absorption of the chancreous pus, without the interference of any external agency. When once the glands in the groin have become specifically irritated, it is extremely difficult, if not impossible, to prevent suppuration from taking place. Most usually only one or two glands suppurate, although several may be enlarged; and very commonly the disease is confined to one groin only, though both may be affected, more particularly if the chancre be situated upon the frenum. The suppuration may be limited to the gland immediately affected, or it may extend into the surrounding cellular tissue, or even be chiefly confined to this.

The true specific syphilitic bubo is essentially produced by the absorption and deposit of the venereal virus in the substance of the gland, the tissue of which becomes poisoned; so that we may consider with Ricord that a bubo is, properly speaking, a chancre of an absorbent gland, differing only in seat from that which is situated upon the surface of the body. Ricord has observed, and I have often had an opportunity of testing the correctness of

this observation, that the pus of a syphilitic bubo is as readily inoculable as that of an ordinary chancre. The ordinary syphilitic bubo, then, may be considered as a *specific* abscess of the absorbent glands and surrounding cellular tissue. It runs the ordinary course of an acute abscess, often undermining the skin to a considerable extent, with much red or purple discoloration, and when it has burst or been opened presents a ragged sloughy-looking cavity, having an unhealthy appearance; it most usually occurs about the second or third week after the first appearance of the chancre, but may happen at an earlier or at a later period.

Primary Bubo.—The French surgeons have described a form of bubo that they call *bubon d'emblée*, or *primary bubo*; this is said to occur from the direct absorption of the syphilitic poison, without the previous formation of a chancre. It is seldom that satisfactory proof can be given of the existence of such a bubo. It frequently happens that small excoriated chancres heal in a few days, before which time, however, the inguinal glands have become irritated and enlarged; and as the enlargement of the glands goes on after the healing of the chancre, a bubo may be formed when all trace of its primary source has entirely disappeared.

Primary bubo has fallen under my observation in one case only; and, until that occurred, I doubted its existence. In the case referred to, a young man applied to me with a rather large abscess in the groin, for which I sent him into the hospital. On being questioned, he denied ever having had any syphilitic disease, though he admitted having had intercourse with a woman of the town. On examining the penis, no chancre, abrasion, or cicatrix could be discerned. The abscess was opened, and two ounces of rather bloody and very thick pus were let out; no enlarged glands could be seen. As the pus looked suspicious, it was inoculated into the left thigh, when two distinct and well marked chancreous pustules were produced.

Creeping Bubo.—In some cases the bubo, as has been well shown by Mr. Solly, assumes a tendency to creep or spread over the neighbouring integument, extending in this way to a considerable distance down the thigh, upon the abdomen, or over the ilium. This *creeping bubo* is characterised by the peculiar semicircular or horse-shoe shape that the sore assumes, and by its tendency to cicatrize by one margin, whilst it slowly extends by the other, the cicatrix always being thin, blue, and weak, closely resembling that of a burn.

After a bubo has disappeared, a good deal of induration may be left in the glands of the groin, together perhaps with matting of the surrounding cellular tissue; and this induration may continue for years, or even for the remainder of life.

The *Treatment* of bubo consists, in the first instance, in endeavouring to prevent the occurrence of suppuration; and, should this take place, in letting out the matter and closing the wound which results.

The *preventive treatment* of bubo is of considerable moment; for if suppuration take place, a tedious result will often be entailed on the patient. It consists essentially in perfect rest of the part, the application of leeches, and of cold lead poultices. At the same time, the free internal administration of mercury as for a chancre should be persevered in; for not only has this a tendency to promote the resolution of the swelling, but also to prevent the infection of the constitution, which readily takes place when once the poison has entered the absorbent system. The employment of antimonials in nauseating doses has been strongly recommended by Mr. Milton, and deserves, I think, the attention of the profession. In reference to the application of leeches there is a practical point of considerable importance

that requires attention—viz., that the leech-bites may become infected by the chancreous pus, and thus converted into a number of new chancres. This accident is best guarded against by covering the bites with collodion and plaster.

If there be not much inflammatory action about the bubo, but if this be indolent and chronic, the application of blisters, of discutient plasters, or of the tincture of iodine, is occasionally useful. A plan of discutient treatment recommended by a French army-surgeon, M. Malplaquet, I have found very serviceable in several cases. It consists in applying a blister about as large as a half crown over the surface of the inflamed gland, and dressing the raw surface produced by it with a piece of lint soaked in a saturated solution of the bichloride of mercury for a couple of hours, when a white eschar will have formed; a cold poultice should then be applied, and continued until all excited action has gone down.

If, notwithstanding our endeavours to prevent suppuration, matter form within or around the gland, as evinced by the swelling becoming soft, boggy, and inflamed, it should be *freely opened* by either a horizontal or a vertical incision, whichever will give the readiest outlet to the pus. If the integuments be much thinned, undermined, and of a bluish colour, I prefer making the opening with *potassa fusa*, as it destroys those unhealthy tissues which would otherwise interfere with the cicatrization of the wound. The cavity that is now exposed presents a chancreous appearance, being irregular and sloughy, with elevated and angry red edges. This should be dressed with the aromatic wine and tannin lotion, at the same time that the system is kept under the influence of mercury. In open bubo of a truly venereal character, the continuous administration of mercury is fully as necessary as in the treatment of an indurated chancre on the penis; the bubonic sore being nothing else, in point of fact, than a chancre in the groin. If we find that the character of the sore does not improve, the *potassa fusa* should be freely applied to its surface and edges, and after the sloughs have separated, the granulations may be dusted with red precipitate powder; the cicatrization will in many cases be much facilitated by the application of a compress, with a spica bandage, and by keeping the patient at rest. Not unfrequently the healing of the sore is interfered with by the overlapping of the undermined edges; these may occasionally be made to retract by being freely rubbed with the nitrate of silver. If this do not succeed, it may be necessary to pare them off with a knife or scissars, or to destroy them with *potassa fusa*; the sore should then be dressed from the bottom, and treated on general principles. Sometimes sloughing action is set up in the open bubo, and then extensive destruction of tissue may ensue, and even fatal hemorrhage from the femoral artery has been known to occur.

VENEREAL WARTS.—Various forms of warts occur as the result of primary disease, independently of any constitutional affection, arising from simple irritation of the muco-cutaneous surfaces; but besides these, warts or verrucae of a truly specific and contagious character are met with. These commonly occur on the prepuce or glans, and are especially apt to be situated in the angle between these parts; they are of a bright-red colour, very vascular, and, if left without interference, may increase immensely in size and number, distending the prepuce, and giving a clubbed appearance to the penis; there is always phimosis attending them, and the tension of the prepuce may be such, that ulceration occasionally takes place in it, giving rise to a protrusion of these growths through an aperture in its side. These warts are occasionally met with in the vagina, forming large, irregular, cauliflower-looking masses. The Treatment consists in snipping and paring

them off with scissors, and afterwards touching the parts from which they spring with nitrate of silver, to prevent their recurrence. In order to do this effectually, it is necessary to lay open the prepuce in all those cases in which the glans cannot be freely exposed by drawing this back.

CONSTITUTIONAL OR SECONDARY SYPHILIS.

By *Constitutional Syphilis* is meant the general infection of the system by the venereal poison. This form of syphilis is commonly called *Secondary*, in contradistinction to the *Primary* or local disease. In the great majority of instances, it occurs from the absorption of the syphilitic poison directly from a chancre. The constitutional disease is often, but not necessarily, preceded by the formation of bubo. It may, however, as will immediately be stated, occur in other and less direct ways. It manifests itself not so much by the occurrence of any one special disease, as by the tendency it occasions to the development of inflammation in various tissues and organs, and by the peculiar impress that it communicates to the form and course of the inflammatory affections it induces.

TRANSMISSIBILITY.—The question as to the contagiousness of secondary syphilitic sores, or of the secretions of individuals labouring under constitutional syphilis, is one that is at present in a very unsettled state; and, before it can be settled, very extended and accurate observation is required for the elimination of those sources of error, which are inseparable from an inquiry in which the morality of patients often constitutes an important element in the investigations. The following appear to me to be the chief points that may be looked upon as decided with tolerable accuracy, though many of them are still subjects of controversy.

Constitutional syphilis is not usually contagious; that is to say, it is not communicable from one individual to another through the medium of the pus of one of the sores that may form during its continuance. This point, which I look upon as one of the fundamental doctrines in syphilis, has in my opinion been incontestably proved by the observations of Hunter, and more recently by Ricord, who has shown that the pus from secondary sores is never inoculable. It is, however, hereditarily transmissible from parent to offspring; and it is communicable to the female by impregnation by a diseased male, and possibly through the medium of the semen without impregnation. It is also communicable to the mother from a diseased fœtus in utero, the parent being thus poisoned through her own offspring. There are certain rare cases in which it seems to be communicated from nurses to children, and *vice versa*, in the act of suckling, through the medium of sores or mucous tubercles on the nipple or mouth, and possibly through the secretions. And there occasionally occur doubtful cases in which the male appears to receive infection from the diseased secretions of a syphilitic female during sexual intercourse, without there being any actual local sore through which the poison can be proved to be conveyed into the system.

PERIOD.—The period at which constitutional syphilis declares itself when occurring as the direct consequence of a chancre, usually varies from six weeks to six months after the occurrence of the local disease. Occasionally it shows itself earlier, about the second or third week, when it may be coincident with the existence of primary syphilis, in other cases, again, it does not manifest itself for years after the primary disease. Most commonly its symptoms are progressive—the milder, such as the affections of the skin and mucous membrane, occurring first; the more severe, as those of the bones and organs, afterwards; but in other cases this progression is not observed,

symptoms of great intensity setting in early, without being preceded by those of a slighter kind.

Constitutional syphilis gives rise to two very important groups of phenomena: first, those that affect the system generally, influencing deeply the condition of the blood and the nutrition of all the textures of the body, occasioning febrile disturbance, followed by emaciation, cachexy, and general evidences of malnutrition: secondly, a variety of local diseases, which are characterised by three distinct phenomena:—1. Modification of the epidermis and epithelium, as observed in mucous tubercles, psoriasis, and analogous affections; 2. Ulcerations, affecting the skin and mucous membranes in various parts of the body; and 3. The deposit of lowly organised lymph in various tissues and organs, as the periosteum, the iris, testes, &c.

When once syphilis has become constitutional, it is extremely difficult to say when it can be eradicated from the system; and indeed it is a question whether it may not impress the constitution in a peculiar way, modifying certain actions during the rest of life, as we know is the case in other specific diseases, such as cow-pox or scarlet-fever. Certain it is that, if neglected or improperly treated, it will affect the system for an indefinite time, declaring its existence by exciting and modifying various local inflammations years after the original absorption of the poison. Ricord inclines to the belief that a person who has once had secondary symptoms, and got well of the constitutional affection, cannot have them a second time, though he contract a fresh chancre; and Mr. E. Wilson attributes many of the ordinary non-specific cutaneous diseases to the latent influence of constitutional syphilis. Without perhaps admitting to their full extent the doctrines of these surgeons, I certainly think that daily experience tends to show that in many constitutions syphilis cannot be eradicated, and that in most others, when once it has occurred, it is apt, even when apparently cured, to modify certain cutaneous and other affections in a remarkable manner, after a lapse of many years; showing clearly that, if the poison no longer exist in the system, the constitution has received a peculiar impress from it, which it is long in losing. Those remote effects of syphilis have by Ricord been called *Tertiary*. This term is convenient, as indicating a peculiar stage of the constitutional manifestations, in which the tissues are more deeply affected than in the secondary forms of the disease.

Although the disease may continue to modify the system for years, or even for life, yet it seldom proves fatal. In some cases, however, death may occur, either by the cachexy that is induced, by the supervention of phthisis, or by caries of the skull and consequent disease of the brain. fatal and specific syphilitic diseases of the lungs and brain have been spoken of, but I do not think we possess positive evidence of the existence of such affections.

It is especially when the disease has reached the tertiary stage that it runs so protracted and tedious a course. When the syphilitic manifestations are confined to affections of the cutaneous and mucous surfaces, the disease may, and does occasionally, wear itself out—the *materia morbi* being apparently carried off by the secretions of these tissues; and it is only in this way, I believe, that the affection can be eradicated from the system.

That constitutional syphilis is dependent on the absorption of the syphilitic poison into the blood, and its consequent general diffusion through the system, there can be little doubt. Not only is this rendered evident by the great variety of tissues and organs in which it manifests itself locally, but also in the induction of the peculiar syphilitic cachexy.

PHENOMENA.—Constitutional syphilis may affect the following tissues.

and organs, and usually does so in the order in which they are mentioned :—viz., the skin, mucous membranes, periosteum, and bones; the throat, tonsils, palate, eyes, nose, larynx, tongue, and testes.

The first occurrence of constitutional syphilis is often ushered in by febrile symptoms. In proportion to the severity of these, is usually the rapidity of the progress and the extent of the local manifestations. In this febrile disturbance, the nutrition of all the tissues of the body becomes seriously impaired, and the patient acquires a peculiar cachectic look.

In other cases the patient gradually falls into a feeble and emaciated condition, becoming sallow and earthy-looking, with loss of hair, and depression of mental and bodily vigour. In this condition not only are the nutritive functions impaired, as is evidenced by his becoming weak and thin, but the reparative actions are lessened, wounds do not heal kindly, and fractures are slow in uniting.

The syphilitic affections occurring on the skin and mucous membranes are usually of a secondary character, though some belong to the tertiary group; whilst those of the bones and different organs, as the larynx and testes, are commonly tertiary. Although the integumental structures are usually first affected, yet it sometimes happens that the disease manifests itself upon the deeper and more important tissues, without having previously implicated any other.

CIRCUMSTANCES INFLUENCING ITS OCCURRENCE.—Constitutional syphilis is not by any means a necessary consequence of the primary disease; many of those affected with chancre escape all after-consequences. The liability to the occurrence of constitutional symptoms will depend upon the duration and nature of the primary sore, its treatment, and the state of the patient's health.

That the duration of the primary and local disease influences materially the occurrence of constitutional syphilis cannot, I think, be doubted. And although we occasionally see constitutional symptoms occurring in a few weeks after chancres that have been early destroyed, and in other rare instances see chancres existing for months without the induction of secondary symptoms, yet as a general rule it may be stated, that the longer the primary sore is allowed to continue in a specific state, the more deeply will the constitution become infected by the syphilitic poison. Ricord, indeed, states that there is no instance of secondary syphilis occurring, if the chancre be destroyed before the fifth day after the inoculation of the poison. This may be so; but the statement appears to me to be scarcely capable of proof, as it is certainly of very rare occurrence for a chancre to be detected and completely destroyed, so as to be converted into a simple granulating sore, by the fifth day after the infection. It is seldom that it is observed much before this period, and even if it were, no surgeon could be sure of its complete destruction at so early a period after its occurrence. Ricord also appears to incline to the belief that the quantity of pus absorbed from these primary sores destroyed before the fifth day does not influence the nature or severity of the secondary symptoms, and, in fact, that the patient runs no greater risk from one than from a dozen of them. In this doctrine I cannot agree; for I can see no reason for placing syphilis in a different category from any other animal or vegetable poison, in all of which the constitutional effects are certainly proportioned to the extent of the local infection; at the same time, I fully admit that the treatment of the sore, and the state of the patient's health, influence the severity of the constitutional phenomena to a very considerable extent, and probably, indeed, to a greater degree than any other cause.

That the treatment of the primary sore exercises considerable influence

cannot be doubted. The liability to constitutional syphilis is, I believe, materially lessened by a mercurial course, and the severity of the secondary symptoms is not in any way increased, if that course be properly conducted.

The *state of the patient's health* also greatly influences the probability of the occurrence of constitutional syphilis. If, after the cure of the primary disease, his health continue good, no infection of the system will manifest itself; but if it be broken or cachectic, then secondary syphilis will occur contemporaneously with, or at a very early period after, the primary disease; and, indeed, I generally look upon the chance of the speedy supervention of secondary syphilis as more immediately dependent on this than on any other cause. It is remarkable for how long a time the syphilitic poison will continue dormant in the constitution without producing any local manifestation of its existence, until this is developed under the influence of a broken state of health. I have had under my care an extremely severe case of constitutional syphilis, in which twelve years elapsed since the occurrence of the primary disease, during the whole of which time no secondary affection occurred until the patient's health gave way from other causes. And I have also had under my care an officer, in whom constitutional syphilis in a very severe form occurred, for the first time, after salivation for hepatic disease, five years after the primary sore had been contracted—no constitutional manifestation having declared itself in the meanwhile. Not only does a state of ill-health hasten the occurrence of secondary syphilis, but cachexy, neglect, or indifference to its existence, may keep it up indistinctly.

But not only is the liability to the occurrence of the constitutional symptoms influenced by the causes that have just been discussed; it is likewise modified to a considerable extent by the *character of the primary sore*. Ricord states—and he is followed by many writers on syphilis—that the *simple soft chancre* is a purely local affection, that it never infects the system, and is never followed by constitutional symptoms. This is a doctrine which is not consistent with my own observation, and to which I cannot subscribe. That the *soft chancre* is not necessarily followed by constitutional symptoms, I am quite ready to admit; that in the great majority of cases even, if properly treated, it does not infect the constitution, I fully believe; but that, if neglected, if allowed to run its natural course, or if imperfectly treated, it will give rise to constitutional syphilis, I have not the least doubt, as several cases of the kind which I have had an opportunity of watching throughout, and in which there has not, from first to last, been a particle of induration, have occurred to me in my practice. This point is at last one of observation, and a single positive fact must overturn any amount of negative evidence that may be brought forward.

Indurated chancres, on the other hand, are usually followed by constitutional infection, even when carefully and judiciously treated. When allowed to run their own course, they necessarily and inevitably contaminate the system. *Phagedenic chancres*, though not indurated, are frequently followed by constitutional symptoms. But in the sloughing chancre there is less liability to this occurrence, the syphilitic poison appearing to be destroyed by the very intensity of the gangrenous inflammation that accompanies it.

The question as to there being any connection between the nature of the *primary sore* and the *character of the consecutive constitutional affection*, has been much discussed; and though I cannot agree with the doctrine of the plurality of venereal poisons, yet I hold with Carmichael, that the different forms of primary sore will, if left to themselves, be

followed each by its own peculiar train of constitutional symptoms. In fact I am fully convinced, as the result of much and close observation on this point, that there is a general correspondence between the kind of ulcer and the constitutional syphilis that follows it; both, in fact, being chiefly dependent upon the state of the patient's health. The same condition of system, for instance, that will give rise to a phagedænic or sloughing chancre, will occasion rupia or ecthyma, with necrosis or caries of the bones, as the constitutional manifestations; whereas that which occasions the indurated chancre will equally modify the secondary disease, so that it assumes a squamous form, accompanied perhaps by iritis and periosteal disease; and the soft or excoriated chancre will generally be followed by papular or roseolar eruptions, with mucous tubercles on the tongue or throat. That these sequences are of very frequent occurrence I cannot doubt, having so frequently observed them; and that they are not of constant occurrence is, I believe, owing to the character of the constitutional affection being often modified, by the state of the patient's health having undergone a change subsequently to the cure of the primary sore. Thus a patient having indurated chancre, will usually get psoriasis as the secondary cutaneous disease; but if he fall into a cachectic state of health between the healing of the chancre and the supervention of the constitutional affection, rupia will manifest itself.

TREATMENT.—In the treatment of constitutional syphilis, our object is not so much to relieve or to remove any local morbid condition, as to eradicate a poison from the system; and, indeed, the various local manifestations, more especially those that appear upon the cutaneous and mucous surfaces, may rather be looked upon as efforts of nature for the elimination of the virus from the system through the medium of the great excretory and emunctory organs; and it is often apparently by aiding this natural action by the administration of those remedies that act upon these tissues, that the poison is most effectually eradicated.

During the continuance of the pyrexia which often ushers in the secondary symptoms, little can be done in the way of specific means for the removal of the disease from the system; rest and mild antiphlogistic treatment being all that can be accomplished during this, the stage of invasion and of constitutional reaction. At a later period, when the cachexy which is attendant on the disease has declared itself, attention to the hygienic and dietetic management of the patient is of the utmost importance; a light nourishing diet, often accompanied by the moderate use of wine or beer, and, in some of the lower forms of secondary syphilis occurring as the result of phagedænic chancres in broken constitutions, a general tonic plan of treatment, such as the administration of bark, quinine, or iron, and more especially of cod-liver oil, with the mineral acids and sarsaparilla, are required in combination with the more specific means that we possess for the eradication of the disease from the system. These hygienic and tonic remedies must be administered in accordance with general medical principles, and no special instructions need consequently be laid down for their use here.

The treatment of constitutional syphilis is conducted on one of these principles.—1, by the administration of mercury, with the view of directly and specially eliminating the poison from the system; 2, by the preparations of iodine, which are supposed to be specific in a minor degree than mercury in this disease; and 3, by simple attention to the state of the general health, without any attempt at specific treatment. These different principles may be employed simultaneously or consecutively. As a general rule it may be stated that, the longer the interval that separates the constitutional from

the primary symptoms, the more they partake of a *tertiary* character the less necessity will there be for specific treatment, and the more important will be the employment of all means calculated to improve the health.

Of the value of *mercury* in constitutional syphilis every surgeon of experience must have had abundant proof. It may admit of doubt whether mercury can be justly considered as exercising a *specific* action, as there are some cases of the disease that it certainly does not appear to influence in a beneficial manner, and others the severity of which is certainly increased by the administration of this remedy; but it appears to me that in these cases it is rather the patient's constitution, which does not bear the remedy well, than the disease that is at fault. We know that, in many states of the system, and in many individuals unaffected by syphilis, mercury acts injuriously, more especially when anything like cachexy is present, and we cannot but suppose that the same injurious influence on a particular state of body must continue, though it be contaminated with the poison of syphilis. The best proof that we possess of the influence of mercury on constitutional syphilis—an influence, indeed, that almost approaches to the nature of a specific action—is in the case of infantile syphilis, here mercury will not only cure the disease, but will eradicate the virus from the system in a way that no other remedy can accomplish.

In the treatment of constitutional syphilis with mercury, everything depends on the proper administration of the remedy at a suitable period of the case, and in a fitting condition of the constitution. The question as to the propriety of the administration of mercury in constitutional syphilis, the particular preparation to be used, and the period of the disease in which it should be given, must be determined in a great measure by the previous treatment of the primary disease, by the condition of the patient's general health, and by the duration of the secondary symptoms. If mercury have been freely given, perhaps in repeated, irregular, and ill-conducted courses, for the cure of the primary affection; if the patient have fallen into a cachectic state, having lost flesh, colour, appetite, and spirits, if the constitutional affection have assumed the tertiary form, and have deeply implicated the bones, this medicine should not be given at all; or, at all events, not without proper previous preparation. Under these circumstances I think we should endeavour, if possible, to remove the constitutional affection without mercury. It is true that in many cases we shall not succeed in doing so; but at least we improve the health, check the disease, and bring the patient into a proper condition to support a mercurial course, should it be thought necessary eventually to subject him to one. It is in these conditions of the system that the *nitro-muriatic acid* and *sarsaparilla* are of much service. From twenty to thirty minims of the dilute acid, with half an ounce of the fluid extract of sarsaparilla in four ounces of water, may be administered three times a day. To this the *iodide of potassium*, in five-grain doses, may often be advantageously added, or this salt may be given alone in some bitter infusion, as of cascara, quassia, or bark; or, if the patient be in a very cachectic and emaciated state, in cod-liver oil. The *iodides of sodium* and of *ammonium* have also been highly spoken of, especially by some Italian practitioners, in the treatment of secondary syphilis. It is in those cases, likewise, that the preparations of *iron* may be given with much advantage. When there is great emaciation, I have found the combination of the *iodides of potassium* and of *iron* with cod liver oil to be especially beneficial. But useful as these remedies, especially *iodide of potassium* and the dilute mineral acids, unquestionably are, more especially when administered in the case

pound decoction of sarsaparilla, I do not believe that they exercise any specific influence on the disease, or that they do more than relieve or remove local manifestations, often of a troublesome and disfiguring character; failing altogether to cure the constitutional affections and to eradicate the virus from the system, for the removal of which mercury will at last be required. Their great utility appears to consist in removing cachexy, and in restoring the vigour of the nutritive and reparative actions, which are in abeyance; and, by improving the general tone of the system, in enabling it to resist more effectually the advance of the disease, and in some cases, perhaps, to allow this to wear itself out. That great advantage results from maintaining the tone of the system in syphilis is undoubted; we always find that the intensity of the ravages of the venereal poison are in direct proportion to the debility and want of resisting power in the constitution of the patient. Besides being useful in this way, these remedies are often of service in removing local affections, and in repairing the injury inflicted upon tissues and organs by the low and specific inflammation that is set up in them. In this respect, indeed, nothing can exceed the value of these remedies in constitutional syphilis. I do not, however, believe, that the disease can be eradicated from the system by these means, or that any of these remedies, even the iodide of potassium, can take the place of mercury in the treatment of constitutional syphilis; indeed, I cannot call to mind a single case in which this form of the affection has been radically and permanently cured without the administration of mercury. Those cases in which they exercise most beneficial influence, are certainly instances in which mercury has been injudiciously administered, either for the primary or the secondary disease, and in which the powers of the constitution have in this way been sapped. Under these circumstances, a course of the iodide of potassium, or of the mineral acids, in sarsaparilla, should always be administered, with the view of improving the patient's general health.

Looking, therefore, upon mercury as the only remedy we possess that influences directly and permanently the venereal poison, I think that it should always be administered in a full course during some period of the treatment of constitutional syphilis. The time at which it should be given is of considerable importance; thus, it must not be administered until the irritatory pyrexia has subsided under the use of ordinary antiphlogistic treatment; nor should it be given if there be a very marked cachexy. After this has been removed, however, by other means, the employment of mercury may be proceeded with.

In administering this remedy for constitutional syphilis, we must not give it largely, so as to affect the system rapidly, but as a mild course for some weeks, so as to act freely upon the secretory and excretory organs, and thus to eliminate the poison from the system. The most useful preparations are the bichloride, in doses from the twelfth to the eighth of a grain; or the iodide, in one-grain doses three times a day. These should be given with sarsaparilla, which keeps up the power of the system and acts freely upon the kidneys and the skin. The mercury should be continued for at least from three to six weeks, until a decided improvement has taken place in the constitutional symptoms. I do not think it desirable to produce salivation; all the good effects of mercury can be obtained far short of this; and indeed, if the remedy be pushed to such a point as to affect the mouth or gums, it will commonly act injuriously, by depressing the powers of the system too much. I therefore think it well to suspend its administration whenever an impression has been made upon the disease, and before its depressing effect has been produced. The cautions necessary during the mercurial course, when

administered for constitutional syphilis, are precisely similar to those that we have described as necessary during the primary treatment of the disease.

In some cases of constitutional syphilis, affecting the skin and more superficial structures, mercury may conveniently be administered by fumigations. This plan of treatment, which has been especially recommended by Mr. Langston Parker and Mr. H. Lee, consists of a combination of vapour bathing and of mercurial fumigation; and these gentlemen speak in the highest terms of the value of this remedy in syphilis, as shortening the duration of ordinary treatment, and permanently curing the disease without the constitution of the patient being in any way injured by its employment. The bathing may also be associated with appropriate internal treatment. During the use of the fumigations, the patient should be dieted, and be put on a full course of sarsaparilla. The bath may be administered every second day, and should consist of about a drachm of cinnabar slowly volatilised by means of a spirit-lamp, at the same time that steam is disengaged from boiling water. In this way I have for some time past used fumigations at the hospital and in private, and with very great success, in cases of syphilitic cachexia with extensive cutaneous disease of an ecchymatous or rupial character, in constitutions in which mercury could not be borne in any more active form. Mr. Lee prefers calomel as the material to be volatilised, fifteen or twenty grains being used on each occasion.

Whatever plan of treatment is adopted, it should be carried out for a sufficient length of time; great evil often resulting by intercepting it too suddenly, and being contented with the removal of the local mischief, whilst the disease is left firmly seated in the constitution.

LOCAL SECONDARY AFFECTIONS.—We shall next proceed to consider the character and treatment of the different *local forms* in which constitutional syphilis manifests itself. These may be considered as they affect different tissues and organs, and require separate consideration, according to the part that is influenced by them. We shall consider them as affecting the skin, the mucous membranes of the mouth, nose, tongue, palate, larynx; the eyes, bones, testes, and muscles.

1. *Syphilitic Affections of the Skin.*—Syphilo-dermata or Syphilides present various modifications of appearance, corresponding pretty closely to the different groups of idiopathic cutaneous diseases; thus we find exanthematous, papular, squamous, vesicular, pustular, and tubercular syphilitic affections of the skin, with various ulcers and growths. These differ from the corresponding simple cutaneous diseases in their redness being more dusky or coppery, in leaving stains of a brownish or purplish hue, in their outline being circular, and in their crusts or scabs being dark, blackish, thick, and rugged-looking. Besides this, syphilis modifies materially the general character of the cuticle, causing it to assume a yellow or earthy tint. The worst forms of these affections are commonly met with on the face and more exposed parts of the body.

Syphilitic skin-diseases arrange themselves under the following groups.

The *Roscola* consists of blotches of a reddish-brown or coppery tint, which becomes more distinct as the redness declines; they vary in size from small circular spots to large and diffused patches. These are usually first observed about the abdomen, and commonly occur early in the disease, often before the primary sore is healed. Syphilitic roscola usually follows the chancreous excoriation, and is very frequently accompanied by an erythematous condition of the throat.

The *Squamous* syphilide occurs in small patches of an irregular shape, of a red and somewhat coppery colour, which are commonly covered with thin

Shiny scales. In many instances the patches are, however, quite smooth, so as to have a glaze and almost shining look. They are usually situated on the inside of the arms and thigh, often on the scrotum and penis, even occurring on the glans. They also frequently appear on the palms and soles, where deep fissures and cracks are met with. About the lips, the squamous syphilide gives rise to deep and troublesome fissures. It is often associated with a deep and excavated ulcer of the tonsils, with inflammation of the iris, and not uncommonly with disease of the periosteum and bones, and almost invariably follows the indurated chancre. Associated with this condition are large brown patches or maculæ, which occur on various parts of the body.

The *Vesicular syphilide* is of very rare occurrence. In one case which fell under my observation, it appeared in the form of clusters of small pointed vesicles, which, on drying, left grey or brownish crusts and coppery marks.

Syphilitic Pustules, on the contrary, commonly occur; beginning as small hard papule of a coppery hue, slowly softening in the centre into a small deep-seated pustule, having a large brown or coppery areola, and forming speedily large circular dark brown, or even black scabs; usually flat and irregularly crusted, at other times conical. When flat, they constitute syphilitic oethyma; when conical, the rupial form of the disease. After their separation, troublesome ulcers of a circular shape, and with rather a foul surface, are commonly left. This disease first appears upon the face, but speedily shows itself on various parts of the body, more especially on the extremities; it commonly occurs as an early sequence of the phagedenic chancre, and is always indicative of constitutional cachexy; when following other forms of chancre, it is, I believe, owing to the system having in the meantime fallen into a low and broken state.

Syphilitic Tubercles commonly occur as an advanced or tertiary symptom: they appear as hard, smooth, flat, and elevated bodies of a reddish brown or purplish colour, seated on the face, the tongue, the limbs, the penis, and the uterus. They may be resolved by proper treatment, but have a great tendency to ulcerate and to destroy the parts on which they are situated, giving rise to large, deep, foul, and serpiginous sores.

Syphilitic Boils of an indolent character, but painful, and discharging a thin ichorous pus, with a core of shreddy cellular tissue, and leaving deep, irregular and foul ulcers, are not uncommonly met with.

Syphilitic Ulcers may result from pustules, tubercles, or boils, or may commence as tertiary sores: they frequently occur where the integuments are thin, or where they are moistened by the natural secretions of the part. They are circular with elevated edges, tend to spread in circles, with a foul greyish surface; often creeping along slowly, and destroying deeply the parts they affect; leaving cicatrices of a bluish or brown colour, thin and smooth, which are apt to break open again on the application of any slight irritation.

The *Hair and Nails* are commonly affected in advanced constitutional syphilis, baldness, constituting *Syphilitic Alopecia*, occurring either generally or in patches, without any apparent disease of the skin. Disease of the nails, *Syphilitic Onychia*, occurs in two forms, either as a foul ulceration between the toes, or else as a chronic inflammation, with fetid discharge in the matrix of the nail, which becomes black, more or less bent, and scales off, with the formation of a dirty ulcer under its detached edge.

The *Treatment of Cutaneous Syphilis* must be conducted in accordance with the general principles already laid down, and with special reference to the characters of the concomitant constitutional condition, or of the other

local manifestations accompanying it. In the early stages, when ushered in by febrile disturbance, a mild antiphlogistic treatment is required; when the pyrexia has been subdued, more specific measures must be had recourse to. In the *vascular* forms, the treatment of the secondary affection should be guided by the previous management of the primary sore. If mercury have been given for this, we should content ourselves with the iodide of potassium in infusion of quassia, or, what is better, in full quantities of the compound decoction of sarsaparilla. Should mercury not have been given in the primary sore, recourse must now be had to it. In the *syphilitic* syphilide, mercury, I think, is always necessary; and here I give the preference to the iodide over the other preparations. In the *psutular* forms, syphilitic rupia and ecthyma, the constitution being commonly shattered, a tonic plan of treatment is required in the first instance; after which the bichloride of mercury in tincture of bark or decoction of sarsaparilla should be steadily administered. In these cases also much benefit will be derived from the mercurial fume-bath. In the *tubercular* syphilide much the same treatment is required as in the last variety; in these cases, however, I have often found Donovan's solution of the greatest possible value, the disease rapidly disappearing under its use; the same plan is required in the management of syphilitic *boils*. In the treatment of secondary syphilitic *ulcers* we shall find it necessary to use caustic freely, with the view of setting up a new and more healthy action in the part. For this purpose nitric acid, or the acid nitrate of mercury, is especially serviceable; on the separation of the slough thus produced, the sore may be dressed with red precipitate powder, or ointment, or the black wash, to which, if there be irritation, opium may be added; the same constitutional treatment, especially Donovan's solution, being employed. In syphilitic *alopecia*, the internal administration of bichloride of mercury with bark or iron, and the external use of a strong stimulant, such as the nitrate of mercury ointment or tincture of lytta, will be found most serviceable; and in syphilitic *onychia*, the free application of nitrate of silver, followed by the black wash, and bichloride of mercury or Donovan's solution internally, is the proper treatment.

2 *Warts, Excrescences, and Vegetations* are commonly met with in constitutional syphilis, especially in the neighbourhood of the mucous canals, being usually situated in the neighbourhood of the anus, perineum, or scrotum; and in the female, upon and within the labia. They are also very frequently met with about the tongue, on the tonsils, palate, and lips. When occurring in the neighbourhood of the organs of generation, they are usually large, flat, soft, slightly elevated, and uniform in structure and appearance, moistened with a good deal of mucous exudation, and a sort of perspirable secretion of the neighbouring skin. When seated in the mouth or throat they are usually small, and not so distinctly elevated or circumscribed, but look rather like a thickened and opaque condition of the mucous membrane in these situations. These secondary warts, *Condylomata* or *Mucous Tubercles*, as they are often termed, differ essentially from the primary vegetations, not only in their appearance and general uniform character, but in being dependent on the constitutional condition of the disease, and not on local causes solely, such as the irritation of discharges and the want of cleanliness. They are also certainly contagious; and I have known instances in which they have been distinctly transmitted in this way. Their *Treatment* must be constitutional as well as local; the constitutional means should consist in the administration of the bichloride of mercury with sarsaparilla; and the best local treatment with which I am acquainted is to rub them freely with the nitrate of silver, dressing the parts in the intervals of the application with chlorinated lotions.

Not being pendulous or distinctly protuberant, they do not, like the primary excrescences, require excision.

3. The *Mucous Membranes of the Mouth, Nose, Pharynx, and Larynx*, are commonly affected with secondary syphilitic eruptions; these assume the form of mucous tubercles, or of the exanthematous, tubercular, and ulcerative syphilides. The *exanthematous* affection, corresponding to the roseolar form of cutaneous syphilis, and arising from the same cause and in the same constitution, principally affects the palate and throat. The *tubercular* variety corresponds to the squamous cutaneous eruptions, and is chiefly met with as flat, hard, and elevated tubercles in the interior of the mouth, nose, and throat. The *ulcerative* affection of the mucous membranes assumes a variety of forms, which will immediately be described, and occurs principally in the throat and nose. The exanthematous affection of the mucous membrane is usually an early sign of constitutional syphilis, frequently showing itself a few weeks after the primary occurrence of the disease. The other varieties belong to the more advanced secondary or tertiary periods.

The syphilitic affections of the mucous membranes so readily extend to, and are so commonly associated with, corresponding disease of the deeper structures, that we shall more conveniently consider their different forms according as they affect distinct organs or parts of the body.

The *Lips* are commonly affected in persons labouring under the squamous syphilide, with fissures or cracks usually somewhat indurated, and very painful in the movements of these parts. In the *Treatment*, the application of a pointed piece of nitrate of silver to the bottom of the crack will give the most effectual relief. The insides of the cheeks are not unfrequently affected in a similar manner, or become the seat of mucous tubercles, which must be treated as has already been stated.

The *Tongue* may be affected with syphilis in various forms; when severely, its disease usually constitutes one of the tertiary varieties of the affection. In many cases the mucous membrane becomes thickened, but preserves a peculiar glossy, semi-transparent, almost gelatinous appearance, and, being irregularly fissured, gives the organ a thick and misshapen look. In other instances, the epithelium is dry, white, and opaque in patches; the surface of the tongue looking as if it had been dyed white here and there. Occasionally, ulcers form upon its surface or sides; these are usually irregular in shape, with a foul surface and a good deal of surrounding induration, and, unless care be taken, may readily be confounded with scirrhus or epithelial cancer of the organ. The diagnosis of these affections we shall consider when speaking of diseases of the tongue generally. Occasionally a hard elevated circumscribed tumour of a dark-red or purplish colour slowly forms towards the centre of this organ; it increases without pain and in a gradual manner, and principally occasions inconvenience by its bulk and the impediment it occasions in the movements of the tongue. These various diseases indicate a deeply seated constitutional affection, and require, as *Treatment*, the administration of mercury in the form either of iodide or of bichloride. Donovan's solution is extremely useful in many of these cases. The ulcers should be touched from time to time with the nitrate of silver.

The syphilitic diseases of the *Throat* are amongst the most common manifestations of constitutional syphilis, and frequently occur early. They present several distinct forms, corresponding to analogous primary and secondary cutaneous affections. One of the earliest conditions is a deep-red exanthematous efflorescence of the soft palate and the pillars of the fauces, either without ulceration, or with but superficial abrasion, but with much

cachexy and depression of power, and perhaps with considerable pyrexia. It often occurs about the period of the invasion of the roseolar or rupial syphilide, and requires the same *Treatment* as is necessary in these affections, together with the local application of a strong solution of the nitrate of silver. A deep excavated ulcer, with a hard base and foul greyish surface, of circular or oval form, is not unfrequently met with on one or the other tonsil; it corresponds to that class of secondary phenomena that follows the indurated chancre, and requires mercury in some form for its cure; in this and many other cases the mineral may most conveniently be applied to the throat by means of fumigation. A sloughing ulcer is occasionally seen on the side of the throat or palate, with much swelling, a foul grey surface, and rapid destruction of parts, giving rise very commonly to perforation of the soft palate, and thus, by partially destroying the curtain between the mouth and the nose, occasioning serious inconvenience to the patient during deglutition and in speech. This form of ulcer is connected with the rupial or ethymatous syphilides, and requires the same *Constitutional Treatment* as these. The best *local* plan is free sponging with strong nitric acid, and gargling with solutions of the chlorides. More rarely a form of the serpiginous ulceration is met with, producing considerable contraction and inconvenient consolidation of tissues after its cure. It is, I think, best treated by the local application of nitric acid, and the internal administration of bichloride of mercury.

The mucous membrane of the *Larynx* is not unfrequently affected in advanced syphilis. In these cases, chronic inflammation, with thickening and ulceration, takes place about the rima glottidis, with the general and local symptoms of chronic laryngitis; such as huskiness of voice, cough, and expectoration of tenacious or offensive mucus; a difficulty in deglutition, and a tendency to choking on swallowing liquids, with tenderness on pressure about the throat, also come on. These cases are usually accompanied by much constitutional cachexy, and not unfrequently eventually terminate fatally by the sudden supervention of oedema glottidis. The *Constitutional Treatment* must depend upon the concomitant symptoms and the general state of the patient; most commonly tonics will be required. The *Local Means* consist in the free application of the solution of the nitrate of silver to the rima glottidis, and the occasional employment of counter-irritation. In syphilitic ulceration occurring about the sides or base of the epiglottis, care must be taken in the application of the stronger escharotics, such as nitric acid, or the acid nitrate of mercury; as a small quantity of these, if inhaled into the larynx, might produce serious difficulty in breathing or even fatal asphyxia. In many cases it may become necessary to open the windpipe, in order to prevent the patient from dying of asphyxia; this must be done in accordance with the rules that will be laid down when treating of chronic laryngitis.

The *Nose* is commonly affected in constitutional syphilis, and often destructively so, especially in individuals much exposed to changes of temperature, and who are unable to pay proper attention to their treatment. The mucous membrane becomes chronically thickened, with discharge of blood and pus, coryza, and habitual snuffing. In other cases ulceration takes place, with a very fetid odour of the breath, and the formation of thick ethymatous crusts on the septum, or between this and the alæ. This ulceration is of a very persistent and troublesome character, and requires usually a mercurial treatment with the local application of strong nitric acid, or of the acid nitrate of mercury, to arrest its progress. In many cases ulceration will rapidly proceed to destruction and perforation of the septum,

or necrosis of the spongy bones, the vomer, and ethmoid; sometimes excavating the whole of the interior of the nose, scooping and cleaning it out into one vast chasm. When this happens the nasal bones are usually implicated, being flattened, broken down, and destroyed; the alae and columna ulcerating away, and producing vast disfigurement. Occasionally the disease extends to the bones of the base of the skull, and in this way may occasion amaurosis, epilepsy, or death. The *Treatment* of these nasal affections must be conducted in accordance with general principles. In many cases mercurial fumigation is extremely useful; in others, where the disease is of an ulcerative character, the strong acid and caustic applications already mentioned, with chlorinated solutions occasionally sniffed up, will do much to stop the progress of the disease. As necrosis occurs, the dead bone must be removed.

4. *Syphilitic Iritis* commonly follows the indurated chancre, being associated with some of the more advanced secondary sequelae of that form of the disease. It usually occurs after exposure to cold, and often in people that are otherwise strong and healthy. The ordinary symptoms of iritis, somewhat modified, characterise the affection. The patient complains of dimness of sight, pain in the eye, and often of very severe circumorbital or hemicranial pain. On examining the eye, the conjunctiva will be found to be slightly injected, and a zone of pink vessels to be seated on the sclerotic, close to the cornea; the aqueous humour has lost its transparency, giving a muddy look to the eye, and the colour of the iris is altered. The pupil is irregular in shape, usually angular towards the nasal side, and small yellowish or brownish nodules of lymph may be seen to be deposited on the surface of the iris. If the case be left to itself, or be improperly treated, it will advance to disorganisation or to permanent opacity of the eye.

The *Treatment* of these cases consists in local depletion by means of cupping and leeches to the temples, and the administration of calomel and opium internally, at the same time that a drop of the solution of atropine is put into the eye. Most commonly, as the mouth becomes affected by the mercurial, the eye will clear, the lymph becoming absorbed, and the pupil regaining its normal shape and colour. In some cases, however, a chronic inflammation continues; under these circumstances, the best effects result from the administration of small doses of bichloride of mercury, with repeated blistering to the temples; and, in a later stage, soda and bark may be advantageously given.

5. *Diseases of the Periosteum and Bones* are amongst the more remote and severe effects of constitutional syphilis, when it has reached the tertiary stage. They are especially apt to occur in cases in which mercury has been improperly administered, and after the patient has passed through the whole course of the less severe syphilitic affections, such as those of the skin, mucous membrane, and throat. These affections, however, especially of the periosteum, are not necessarily preceded by the minor constitutional effects, but may in some cases declare themselves at the same time with the affections of the skin and mucous membranes. They more commonly occur amongst the poorer classes, especially those who are exposed to atmospheric vicissitudes, and chiefly in strumous constitutions.

General Periarthritis or *Nodes* may occur on almost any of the bones; but the disease is most commonly met with on the tibia, the clavicle, or the bones of the forearm. Some joints are also not unfrequently affected by it, the sterno-clavicular articulation and the knee-joint are especially often its seats.

Nodes are indolent, elongated, uniform, and hard swellings, sometimes tender on pressure, and generally but little painful during the day; but at

night the aggravation of pain is peculiarly marked, and constitutes perhaps the most distressing symptom in these cases. They consist of a thickened state of the periosteum, with some plastic effusion within and underneath it, and occasionally thickening of the subjacent bone; they may continue permanently or may terminate by resolution; it is seldom that they suppurate, unless there be disease of the subjacent bone. The *Treatment* consists, if there be much tenderness, in the application of leeches; if there be no great sensibility on pressure, but considerable nocturnal pain, blisters should be applied. When in a chronic state, the tincture of iodine is a useful application. Nodes sometimes become soft and prominent, and feel semi-fluctuating, especially when seated on the cranium, so as almost to tempt the surgeon to make an opening into them; this, however, should never be done, as the swelling, however great, will subside under proper treatment. For the ultimate removal of the tumour, and the relief of the nocturnal pains, we possess an excellent and sure remedy in the iodide of potassium.

Other fibrous membranes besides the periosteum may become diseased in constitutional syphilis, and masses of dense lymph in the form of warty tumours or excrescences may be deposited upon them as the consequence of the specific inflammation. This is particularly the case with the dura mater. As one of the ulterior effects of tertiary syphilis, structural changes of this kind may take place in and upon it, giving rise to epileptiform seizures, and eventually coma and death, partly from pressure, partly from irritation.

The *Veneral Affections of the Bones* are principally met with in those that are flat and compact, as the cranial, nasal, and maxillary bones. In these, various forms of disease occur. One of the most common is perhaps *Chronic Osteitis*, with hypertrophy and condensation of the osseous tissues, often to a very marked extent. This affection may occur in the bones of the skull, but is also met with in some of the long bones, as the tibia and the ulna; it is characterized by very severe pain, especially of a nocturnal character, accompanying the enlarged and thickened state of the bone.

Syphilitic Necrosis chiefly occurs in the bones of the skull and jaws, the alveolar processes of which may exfoliate; the palatine process of the superior maxillary bone, the spongy and the nasal bones, are also commonly destroyed by this morbid action; but it is a remarkable fact that the palate-bones are rarely if ever affected. In consequence of this destruction of bony tissue, the interior of the nose becomes chronically diseased, the organ may fall in, or a communication may be established between the nose and the mouth through the hard palate.

Syphilitic Caries, or ulceration of bone, presents different forms, which, according to Mr. Stanley, correspond to analogous ulcers and eruptions of the skin. Thus, there may be the *simple ulcer* of the bone, showing a rough, irregular, porous, and depressed surface; the *worm-eaten caries* consisting of small pits or excavations, studding the surface; and the *serpiginous* or *creeping ulcer*, marked by imperfect attempts at repair, and the deposition of new bone in nodules or masses. The cranial bones are those that are most commonly affected in this way, and their disease may sometimes prove fatal by the irritation set up by it in the brain or its membranes. The bones of the extremities, however, are not unfrequently similarly affected.

I have twice seen a peculiar *dry caries* of the cancellous structure of the head of the tibia in old syphilitic cases. In both cases, which were very similar, the patients had been affected for a length of time with nodes of the tibia, as a consequence of long antecedent syphilitic taint. Chronic abscess eventually developed itself over the head of the tibia, leading to carious bone. I exposed and gouged this away. It was peculiarly dry,

light, and almost flocculent, if such a term can be employed to bone. Both patients recovered well from the operation; but one of them, a female, died two years afterwards of epilepsy, consequent on syphilitic tumours of the dura mater.

The *Treatment* of syphilitic caries varies somewhat, according to the form which the disease assumes, and the previous management of the patient. In *osteitis*, the principal reliance should be placed upon the conjoined influence of calomel and opium, provided the patient have not previously been fully mercurialised. If he have been so, we must rely chiefly upon iodide of potassium. In syphilitic necrosis, the constitutional cachexy demands the principal share of attention; the necrosed bone should be separated as it becomes loose, the local irritation depending on its presence then subsiding. When the bone has fallen into a carious state, iodide of potassium in combination with iron, cod-liver oil, or sarsaparilla, with the mineral acids, will improve the tone of the system, and stay the progress of the disease. The ulcerated and exposed bone requires to be dressed with strong stimulants; the red oxide of mercury, in ointment or powder, is perhaps the best; in some cases, touching the part freely with the acid nitrate of mercury will establish a more healthy action.

6. Syphilitic disease of the *Testicle* is one of the more advanced conditions of the constitutional affection. It commonly occurs as the result of that train of symptoms that follows the indurated chancre; viz., squamous affections of the skin, the excavated ulcer of the throat, iritis, and nodes, but usually does not appear until these different manifestations of constitutional syphilis have each in their turn passed away; the patient, indeed, appearing to have recovered from all disease, and being otherwise in good health. Commonly the disease may be referred to a blow, a squeeze, the occurrence of gonorrheal epididymitis, or some other local cause. The testis will then be observed gradually to enlarge, until it attains the size of a turkey's egg, or even larger, being ovoid in shape, heavy, and smooth, not painful except by its weight, which causes dragging and uneasy sensations in the cord and loins. This disease is very commonly accompanied by a small hydrocele, constituting, indeed, a hydro-sarcocoele. Most frequently only one testis is affected; it is but very rarely that both are diseased. The affection continues to increase, giving rise to uneasiness from its size and weight, but is not followed by suppuration or other inconvenience.

Mr. Hamilton of Dublin has described another form of syphilitic sarcocoele, under the term "tubercular syphilitic sarcocoele." In this the testis is enlarged to three or four times its natural bulk, of an irregular shape, presenting an uneven, hard, and knotty mass; it is neither painful nor tender, but inconvenient from its weight, causing pains in the loins and cord. Both testes are usually affected, but one is worse than the other; and when the disorganisation is great, Mr. Hamilton states that all sexual desire is lost, and that neither erections nor emissions take place; both, however, returning as the treatment effects the restoration of the organ to its normal condition. In these cases suppuration not unfrequently takes place, followed by the discharge of thin pus, the formation of fistulous openings, and occasionally the protrusion of a fungus. This form of sarcocoele occurs in persons of a broken and cachectic constitution, who are suffering severely from the more advanced and inveterate forms of tertiary syphilis, especially of the bones and throat.

In the simple syphilitic sarcocoele, the enlargement of the testes is principally due to the deposit of semi-transparent white or yellow lymph, in a uniform manner throughout the substance of the organ external to the tubuli.

In the tubercular syphilitic sarcocele, Mr. Hamilton states that tubercles of a yellow colour, and varying in size from a split pea to a chestnut, or even larger, are found in the substance of the organ; these, softening, give rise to suppuration in and around them, and thus to the ultimate disorganisation of the testis, which becomes converted into a hard irregular fibro-cellular mass, in which cretaceous matter is occasionally deposited.

In the *Treatment* of the simple form of sarcocele, a full mercurial course is generally necessary; the bichloride in doses of the twelfth or eighth of a grain three times a day, is the best preparation. This should be continued for at least six or eight weeks, or until hardness disappears. Any hydrocele that exists should be tapped, and the fluid drawn off by means of a small trochar and cannula before the treatment is commenced. After the mercury has been discontinued, the remaining swelling of the testis may be got rid of by the internal administration of iodide of potassium in five-grain doses, twice or thrice daily, with frictions with the iodide of lead ointment. In these cases, care should be taken not to irritate the scrotum with very stimulating applications, as the skin is tender, and readily becomes excoriated; ordinary strapping is of very little use, but in some cases I have found strapping with the plaster of ammoniacum and mercury, diluted with equal parts of belladonna plaster, of service. If suppuration occur, and a fungus protrude, the same treatment must be adopted as will be described when we come to speak of the strumous testicle.

7. *Syphilitic Ovaritis* is a disease that I believe I have on several occasions met with. The history of the cases have been uniformly as follows: a long antecedent attack of syphilis; various constitutional symptoms running through secondary and tertiary stages; inflammatory congestion of one ovary, as determined by abdominal and rectal exploration; eventual cure by means of leeching and the bichloride of mercury and bark;—in fact, a condition of things closely resembling what occurs in syphilitic sarcocele.

8. Besides these various constitutional manifestations of syphilis, tumours of the *Muscles and Tendons*, depending on this disease, have been described by Bouisson. These appear to consist of a limited hypertrophy of the tissue of the muscle, with an effusion of plastic matter in its interior. When affecting the tendons, these tumours are elongated, and resemble nodes upon them. Their presence is attended with some pain during the contraction of the muscle; they are usually somewhat globular, and vary in size from a nut to a pigeon's egg, being accompanied by nocturnal pains. They are best treated by the iodide of potassium.

INFANTILE SYPHILIS.

The existence of a chancre on the labia of the mother may possibly infect the child at birth with primary syphilis, just as it might inoculate the hand of the accoucheur; but syphilis thus contracted by the infant is not the form of the disease that is described as *Infantile Syphilis*. This is a truly hereditary infection, transmitted to the infant at the time of its conception, or communicated to it through the medium of the mother during intra-uterine life, and existing as a constitutional affection at the time of its birth. Though we may believe that syphilis is not easily eradicated from a system into which it has once been received, and that under certain conditions it may readily be transmitted to the offspring; yet I think that we are still ignorant of the amount and nature of the constitutional affection of the parents that are necessary for the development of syphilis in their children, and that we are certainly not warranted in concluding that a parent who has been, or even who is actually affected by constitutional syphilis, must necessarily

have a syphilitic, or even a feeble and strumous family; although the probability undoubtedly is that such will be the case. I have had under my observation a gentleman whom I had attended for secondary syphilis, and who, contrary to my advice, married a few years ago; and, though he has since then suffered from psoriasis of the hands, mucous tubercles, fissures on the lips and tongue, and venereal sarcocele, yet his wife has borne a perfectly healthy family, not only without any syphilitic taint, but without any apparent constitutional cachexy.

Syphilis, when transmitted by the parents, appears to lessen the vitality of the ovum to such a degree, that it either cannot reach its development, or, if it do so, that the child which is born is not only tainted, but enfeebled in constitution. When the ovum is infected with syphilis, several morbid states may result, according to the intensity of the infection. It may be so blighted that it never reaches the maturity of intra-uterine life, but becomes early aborted; in this way many consecutive miscarriages may happen in consequence of one or both of the parents having constitutional syphilis, but if they be put under proper treatment by a mercurial course, and the disease be thus eradicated from the system, the ovum will at the next pregnancy probably reach its full development. The embryo may go its full time, and the fetus be born with syphilitic cachexy and local manifestations of the disease fully developed upon it. More frequently, however, it happens that the child, although cachectic and sickly looking, is brought into the world without any syphilitic appearances; but in the course of a few weeks, usually from the third to the eighth, these declare themselves. Constitutional syphilis of a congenital nature may manifest itself even at the adult age. This, though rare, has lately fallen under my observation in a young woman of seventeen who was covered with marked syphilitic psoriasis, with which she had been affected for several years. The mother told me that, shortly after birth, evidences of infantile syphilis had appeared; that these had yielded to treatment, but that, as the period of puberty approached, the psoriasis, which was truly of a syphilitic nature, had shown itself. In other cases, again, it is not impossible that the syphilitic taint may manifest itself in a different way from that which has just been alluded to; that no local manifestation may occur, but that an impaired and depraved state of constitution and of nutritive activity may be inherited, which, in after-life, gives rise to some of the various forms of scrofula or of other constitutional disease, dependent upon an enfeebled state of system, or a diminution, as it were, of the general vitality.

MODE OF COMMUNICATION.—The mode of communication of syphilis to the ovum, or to the intra-uterine fetus, is an investigation that has much occupied the attention of surgeons, and is of considerable practical interest. It appears certain that the poison may be communicated to the embryo in at least four ways. Thus, 1, the father may have a constitutional taint of which he has been imperfectly cured, and, without communicating any syphilitic disease to his wife, may be the parent of an offspring that exhibits indications of being infected; or, 2, the mother, having a similar constitutional disease, may in like manner taint her own offspring; or, 3, the diseased child may be born of parents, both of whom are constitutionally infected; or, 4, the mother may become pregnant with a healthy embryo, but, afterwards contracting syphilis, may transmit it to her offspring.

There are several other questions, however, in connection with the transmission of syphilis to and from infants, which are of an intricate character, and have not as yet been cleared up to the satisfaction of all surgeons. Thus, for instance, it has become a question whether a mother, pregnant with

a syphilitic foetus, the offspring of a father labouring under constitutional disease, can be infected through it without herself having had primary syphilis ! Ricord states that a woman may be so infected ; and Mr. J. Hutchinson has lately advanced a considerable amount of evidence in support of this doctrine. Then, again, the question has arisen whether a wet-nurse labouring under constitutional syphilis can infect the child that she suckles, the infant being contaminated through the medium of the milk. Ricord admits this, but Acton states decidedly that the disease cannot be so transmitted. My own opinion is that it can, though rarely, be so transmitted ; and, indeed, there are a number of cases on record in proof of this, in *Ranking's Abstract*, vol. iv. The converse of this is also a matter of dispute—whether a syphilitic child can infect a healthy nurse. This question is one of very great importance, inasmuch as actions for damages have been brought by women who have stated that they have become diseased from the child that they have nursed. Ricord and Acton deny the possibility of this mode of the transmission of syphilis ; but there are cases recorded that prove the contrary, and on such a question as this, one positive fact must necessarily outweigh any amount of negative evidence. Not only have Hunter and Lawrence related cases in which an infected child communicated the disease to several nurses in succession ; in Hunter's case three wet-nurses were successively infected, two of whom gave the disease again to their own children ; but a considerable mass of evidence upon this point is to be found in *Ranking's Abstract*, (*loc. cit.*) The disease is especially apt to be communicated in this way if the nurse have any crack or abrasion upon her nipple, and the infant sores upon the mouth. Dr. Colles, however, who had great experience in syphilis, states that the disease may be communicated to the nurse from an infected child, by mere contact, without excoriation.

SYMPTOMS.—The symptoms of infantile syphilis are sufficiently well marked—consisting principally of cachexy, with disease of the mucous and cutaneous surfaces. The first indication is usually the *atrophic and cachectic appearance* of the child ; this invariably shows itself at birth, syphilitic children being always described as small, shrivelled, wan, and wasted, when born ; the face especially has an aged look, the features being pinched, and the flesh soft and flabby ; the complexion generally has a yellowish or earthy tinge ; and these characters continue until the disease is eradicated from the system of the child. The first local sign that declares itself is usually a congested condition of the mucous membrane of the nose, giving rise to the secretion of offensive mucus, and causing the child to make a peculiar snuffling noise in breathing, as if it had a chronic catarrh ; this snuffling may exist from the time of birth, but generally comes on very shortly afterwards. The mucous membrane of the mouth is also liable to attacks of inflammation, and this *syphilitic stomatitis* is a very marked characteristic of the disease.

The disease manifests itself upon the *cutaneous and mucous surfaces*, sometimes before or at birth, in other cases not until several weeks have elapsed. The most common period for the occurrence of these signs is the third or fourth week. The cutaneous eruption usually makes its appearance on the nates, the scrotum, the soles of the feet, and around the mouth, hence, on examining a syphilitic child, these parts should always be looked at first. It presents itself in three different forms : most frequently as flat tubercles, varying in size from a split pea to a fourpenny piece, smooth, slightly elevated, and of a coppery or reddish-brown colour. These tubercles are often accompanied by cracks and fissures about the mouth and anus. Though commonly called *squamous*, they are not in reality scaly, but are always smooth and

flat. Intermixed with these are brownish maculæ or spots, differing in size, and variously figured.

The vesicular or bullous eruption is not so common as those just described, yet I have frequently seen it in syphilitic children. It appears in the form of vesicles, about the size of a split pea, with a dusky coppery areola and base; drying into brown scales or scabs, and commonly conjoined with the tubercular affection. These bullæ are most frequently seen on the soles of the feet.

When we consider the influence exercised by the syphilitic poison upon the skin, and its appendages the hair and nails, we should *a priori* have expected that the teeth, as a portion of the dermal skeleton, would participate in the morbid action induced by it on the allied structures. The fact of their doing so does not, however, appear to have attracted the notice of any observer, until Mr. J. Hutchinson directed the attention of the profession to this very interesting subject, and pointed out the destructive and special influence exercised upon the teeth by secondary constitutional syphilis. This injurious influence manifests itself both in the temporary and in the permanent teeth, but only with its specific and peculiar characteristics on the permanent set. It must not, however, be supposed that in all cases of secondary syphilis the teeth are affected, indeed, in many instances they are not, and it has been particularly pointed out by Mr. Hutchinson that it is only when there have been attacks of syphilitic stomatitis, that we are to expect to meet with these changes in the teeth from their normal type.

The temporary teeth of syphilitic infants are cut early, are of bad colour, and liable to a crumbling decay (Fig. 176). The upper central incisors usually suffer early and always first; then the laterals become carious and drop out; and, lastly, in some cases though rarely, the canines wear away so as to present a tusk-like appearance. In consequence of the early decay of the incisors children are often edentulous, so far as these teeth are concerned, from an early age, until the permanent ones are cut.



Fig. 176.—Syphilitic Temporary Teeth.

The permanent teeth present the more marked characteristics of an inherited syphilitic taint; and in these, as in the temporary, the disease declares itself chiefly in the incisors of the upper jaw, and first in the central ones. These will be observed to be usually of a bad colour, short, peggy, rounded at the angles, standing apart with interspaces, or converging, and marked by a deep broad notch. They are soft and crumbling, are slender, and readily wear down (Fig. 177).



Fig. 177.—Syphilitic Permanent Teeth.

TREATMENT.—The occurrence of syphilis in the infant may be prevented by putting the infected mother on a mercurial course so soon as her pregnancy is ascertained; this indeed may be necessary in order to prevent miscarriage, but should be done cautiously, and by inunction, rather than by mercury administered by the mouth. Should repeated miscarriages have occurred, as the consequence of constitutional syphilis, one or other, or both the parents, if at fault, should be put upon a mercurial course; and thus the recurrence of this accident may be prevented.

The Curative Treatment as regards the child is extremely simple. It should be brought up by hand, lest it infect the nurse or continue to receive fresh accession of poison from the diseased milk of its mother. It must then be

put under the influence of mercury, which in these cases acts almost as a specific; and, indeed, the ready manner in which all disease may be eradicated from the system of a syphilitic child by this mineral, is perhaps one of the strongest proofs that can be adduced of the specific character of its action on the venereal poison. The mercury may be given by the mouth in the form of small doses of *hydrargyrum cum creta*; but, as it often purges the child when administered in this way, Sir B. Brodie has recommended its introduction into the system by inunction, which process I invariably employ, and have found it a most successful mode of treating the disease. The most convenient plan is, as recommended by Sir Benjamin, to spread a drachm of mercurial ointment on the under part of a flannel roller stretched round the thigh just above the knee, and to renew this every day. The treatment should be continued for two or three weeks, until all rash and snuffling have disappeared, when, the mercury having been discontinued, the cure may be perfected by the administration of small doses of iodide of potassium in milk or cod-liver oil. Occasionally the cutaneous manifestations of infantile syphilis are complicated with, and obscured by, some of the common diseases of the skin incident to early childhood; more particularly with eczema impetiginodes of the head, face, and body. Under these circumstances the diagnosis may not be easy, though the history of the case, the concomitant appearance of two forms of the disease, and the existence of snuffling and cachexy, tend to establish it. The eczema also, under these circumstances, is browner and more squamous than usual. In cases such as these, the best plan is to treat the syphilitic affection first with the mercurial inunction, and then to put the child under a mild course of Donovan's solution, two or three minims for a dose, keeping it at the same time on a good nourishing diet.

DISEASES OF TISSUES.

CHAPTER XXXVII.

SURGICAL DISEASES OF THE SKIN AND ITS APPENDAGES.

THE various specific cutaneous affections, such as eczema, scabies, impetigo, *sene*, lepra, psoriasis, &c., probably fall within the province of the surgeon, and are commonly treated by him in practice; but, as the consideration of these diseases would necessarily lead into the whole subject of Dermatology, the limits of this work would not allow me to discuss so extensive and special a branch of surgery; and I must therefore content myself with the consideration of some of those affections of the skin, which, as requiring manual assistance, may perhaps be more properly looked upon as within the scope of the present Treatise. These diseases may be considered under the several heads of Diseases of the Appendages of the Skin, as of the cuticle and nails; the Non-Malignant Ulcers of the Skin; and the Malignant Ulcers and Tumours of this tissue. We have already, in Chapter XXIX., considered the ordinary non-malignant ulcers of the skin, as well as some of the simple tumours that occur in connection with this tissue; we shall here, therefore, only consider the diseases of the appendages of the skin, and the malignant ulcers and tumours.

DISEASES OF THE APPENDAGES OF THE SKIN.

WARTS consist of elongated papillæ, with strata of thickened and hardened cuticle, usually situated about the hands and face, and chiefly affecting young people: they appear in many cases to be simple overgrowths of the cutaneous structures, coming and going without any evident cause. In other cases again they are of a more permanent character, becoming hardened and dark in colour, and continuing perhaps through life.

The *Treatment* of these affections is usually sufficiently simple. As their vitality is low, they may be readily destroyed by the application of caustics or astringents; among the most useful of these I have found the concentrated acetic acid and the tincture of the sesquichloride of iron. Brodie recommends the solution of a drachm of arsenious acid in half an ounce of nitric acid. In some cases they may be ligatured or snipped off with advantage.

CORNS usually consist of small thickened masses of epidermis, accumulated on those points on which undue friction or pressure has been exercised, in order to guard the subjacent cutis from injury. These epidermic masses are usually hard, dry, and scaly; at other times they are soft and spongy, owing to their being situated in places where the secretions of the skin accumulate, thus keeping them moist. Under old and very thickened corns, it is stated by Brodie that a small bursa is occasionally found. Corns are at all times sufficiently painful, but become especially so if inflammation or suppuration takes place underneath them; the accumulation of a small drop of pus under the thickened cuticle, which prevents its escape, giving rise to very intense agony. There is a special form of corn that I have seen only in the sole of the foot, and which may become the source of the greatest possible pain and inconvenience to the patient, preventing his walking, and in fact completely crippling him. This corn is usually of small size and round in shape, the neighbouring cuticle being always greatly thickened and hardened. It is extremely sensitive to the touch, the patient shrinking when it is pressed upon, as if an exposed nerve had been injured. On slicing it down with a scalpel, it will be found to be composed of soft, tough, and white epidermis, arranged in tufts or small columns, in the centre of each of which a minute black dot is perceptible. Each tuft appears to be an elongated and thickened papilla, and the black speck is a small point of coagulated blood which has been effused into it. Around the depression in which each of these corns is seated, the hardened cuticle forms a kind of wall.

The *Treatment* of ordinary corns consists in shaving or rasping them down so as to prevent the deep layers of cuticle, retained by the indurated superficial ones, from giving rise to pain by pressure on the papillæ of the cutis. Relief may also be afforded by removing all pressure from bearing upon the corn, by attention to the shape of the shoe, and by wearing a piece of soft leather or of amadou, having a hole cut in the centre into which the corn projects. It is well to avoid the application of caustics to ordinary corns; injurious consequences being often produced by these agents, especially in elderly people, in whom fatal gangrenous inflammation, as I have seen in one case, may be excited by their action. If the corn suppurate, it must be poulticed and shaved down, and the drop of pus let out by puncture with a lancet. In the painful papillated corn of the sole of the foot, I have found the application of potassa fusa, so as to destroy it thoroughly, to be the best and the speediest remedy; and as this corn always occurs in young people, no danger attends its use; or a poultice followed by the application of a blister may bring it away.

DISEASES OF THE NAILS.—The nails may become diseased, either by undergoing structural changes, by having their matrix inflamed, or by growing into the soft tissues of the toes.

In some broken states of health, and especially in persons suffering from squamous disease of the skin, the nails occasionally become blackish or dark-brown in colour, are rugged, dry, and cracked, scaling off, as it were, without any apparent affection of the matrix. This condition, of which I have seen several instances, is best cured by a course of alteratives and sarsaparilla, the disease yielding as the general health becomes improved.

ONYCHIA is a disease of the nails dependent on inflammation of the matrix; it occurs under two forms, the *simple* and the *specific*.

In *Simple Onychia* there are redness, heat, and swelling, usually on one side of the nail, in the angle of the tissue in which it is implanted; there is discharge of pus, and the nail gradually loosens, becomes dark-coloured, somewhat shrivelled, and may eventually be thrown off, a new nail making its appearance below, which commonly assumes a somewhat thickened and rugged shape. This disease usually results from slight degrees of violence, as the running of thorns and splinters into the fingers.

The *Treatment* consists in subduing inflammation by local antiphlogistics, poulticing, &c., and watching the growth of the new nail, which may be sometimes usefully directed by the application of a layer of wax.

Specific or Malignant Onychia is a more serious affection, and is often dependent on injuries inflicted on the finger in a syphilitic or cachectic condition of the system. In it a dusky-red or livid inflammation takes place at the sides or root of the nail; ulceration is set up, accompanied by the discharge of sanious and very fetid pus; and large loose granulations spring

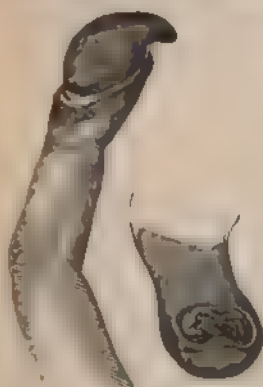


Fig. 178.—Malignant Onychia.

up at its root and sides, so that the end of the toe or finger that is affected, (and this is most commonly either the great toe, the thumb, or the index finger,) becomes greatly enlarged and bulbous in shape. The nail then shrivels, becomes brown or black, and peels off in strips (Fig. 178); after its separation, thick epidermic masses, forming aborted attempts at the production of a new nail, are deposited at the base and sides. In the *Treatment*, both local and constitutional means are required. The first and most essential point is to remove the nail, either in whole or part, as it acts as a foreign body, and prevents the healing of the surface from which it springs; the ulcer should then be well rubbed with the nitrate of silver, and dressed with black wash. Colles recommends fumigating

it with a mercurial candle, made by melting a drachm of cinnabar and two ounces of white wax together. The constitutional treatment consists of means calculated to improve the general health; with this view Sir A. Cooper recommends calomel and opium. I have generally found bichloride of mercury, with sarsaparilla or bark, the most useful remedy.

INGROWING OF THE NAIL is an extremely painful and troublesome affection, principally occurring in the great toe, and brought about by wearing pointed shoes, by which the sides of the soft part of the toe are pressed upon, and made to overlap the edge of the nail. An ulcer here forms, the liability to which is greatly increased by the nail being cut square, so that the flesh presses against a sharp and projecting corner of it; this ulcer

carries a fetid sanious discharge, and large granulations are thrown up by

The consequences of this condition are lameness and inability to walk even stand with comfort.

Treatment.—Various plans have been devised with a view of raising the edge of the nail, partially removing it, and pressing aside the soft structures. I have never, however, seen much permanent benefit result from any of these means; and the only method that is, I think, really serviceable to the patient is the removal of the whole nail. As this operation is an excessively painful one, the patient should be anaesthetised, or the matrix should be rendered insensible by congelation. The surgeon holds the diseased toe in his left hand, and then, running one blade of a strong sharp-pointed pair of scissors under the nail up to its very root, he cuts through its whole length, and, removing the scissors, seizes first one half and then the other with a pair of dissecting forceps, and twists them away from their attachments. The surface left is covered with water-dressing, and speedily throws out granulations which form the rudiments of a new nail. The new nail usually grows straight and healthy. In some rare cases, however, I have seen a faulty direction assumed by it.

Avulsion of the toe-nail is usually unattended by danger. I was, however, once called upon to amputate a foot for gangrene, which had resulted from the operation performed on an elderly person.

HYPERTROPHY OF TOE-NAIL.—Occasionally from neglect the toe-nail may become enormously hypertrophied and twisted, looking more like a horn than a nail, as in the accompanying drawing (Fig. 178), taken from a patient in whom the nail had been allowed to grow uncut for twenty years, producing complete lameness. I removed the nail whole by avulsion, and a sound and useful foot resulted.



Fig. 178.—Hypertrophy of Toe-nail

MALIGNANT TUMOURS AND ULCERS OF THE SKIN.

CHELOID and FIBRO-VASCULAR TUMOURS of the skin are semi-malignant growths situated on the trunk and extremities, usually flat and expanded, oval, round, or irregular in shape, slightly elevated above the surface of the skin, and commonly occurring in otherwise healthy individuals. They may remain stationary for years, but not uncommonly have a tendency eventually to ulcerate, to bleed, and to assume a sort of malignant action; at other times they extend slowly, without ulceration, moving forwards as it were upon the skin, the part over which they have passed assuming much the appearance of the cicatrix of a burn, being red, contracted, drawn in towards the centre, and wrinkled. Closely allied to these are those fibro-plastic growths that have a tendency to sprout up in scars, constituting the *Warty Tumours of Cicatrices*, described by Mr. Hawkins. This morbid condition appears to be simply an abnormal increase in the activity of the development of the cicatricial tissue, which springs up with great luxuriance. They are especially apt to follow the irregular cicatrization of burns, more particularly in children. I have, however, seen them in the adult, occasioned both in this way and by the irritation of a blister. The warty cicatricial tissue chiefly develops on the chest and neck, and is commonly attended by much itching and tingling, often of a most distressing character. It is very vascular, bleeding freely when incised.

Treatment.—These various forms of tumour should, if possible, be extirpated early by the knife, as they do not appear to be amenable to any con-

stitutional or local treatment, and have certainly a disposition to malignant degeneration. As there is a great tendency to local recurrence of the disease after removal, it should be widely excised; but even then it is likely enough to return, requiring perhaps repeated operations before the patient can be freed from it.

LUPUS.—Under the term *lupus*, various semi-malignant and malignant affections of the skin, of very different kinds, are commonly included; indeed, the distinctions between lupus and the different forms of epithelial cancer have not as yet been well made out. There are three forms, at least, in which the diseases included under the term lupus may make their appearance: 1, as a superficial affection of the skin, not attended by ulceration, but accompanied by important and destructive changes in its tissue; this is the *Lupus Non-exedens* of some writers; 2, as a slowly ulcerating form of the disease, giving rise to the different varieties of *Lupoid Ulcer*; and 3, as the *Lupus Exedens*, a disease of a rapidly destructive character, not only eroding superficially, but destroying the tissues deeply. These various forms of lupus are most commonly seated on the face or neck, but are occasionally met with on other parts of the body, as upon the limbs or trunk.

1. *Lupus Non-exedens* appears in the shape of a red patch on the skin, covered by fine branny epidermic desquamation; it may remain stationary for years, or slowly spread over a great extent of surface, producing contraction of the skin, with wrinkling and drawing in of the features, and much stiffness in their movements. The integument affected by it may be in one of two states; it may either continue red, irritable, and branny, having the appearance of a thin cicatricial tissue, and in this way the greater part or the whole of the face may be affected; or it may leave a firm, white, smooth, and depressed cicatrix, exactly resembling that produced by a burn, along the anterior margin of which the disease slowly spreads, in the form of an elevated ridge composed of soft bluish-white or reddish tubercles.

2. *Lupoid Ulcer* usually occurs about the face or neck, but sometimes on the extremities of elderly people, or of those in broken health. It may commence as the last described variety, which after a time breaks into an ulcer; or a small crack forms in the first instance, which scabs over, and, as this scab separates, the characteristic sore appears. It is in the first case a round or oval flat ulcer, without granulations on its surface and without action in it, with somewhat elevated edges, often stationary, at other times slowly extending; in this way it may continue for months upon the cheeks or neck. In other instances it spreads more rapidly, attaining a large size, and presenting a somewhat fungating surface, from which some purulent discharge is thrown off. This form of sore I have most commonly seen about the ears and occiput in elderly persons. In other cases again it spreads with great rapidity, giving rise to extensive ravages; thus, I have seen it extend down the whole side of the neck, from the ear to the clavicle, cleanly dissecting away the skin, and exposing the structures immediately subjacent, as the acromial and clavicular branches of the cervical plexus of nerves, and destroying the patient by exhaustion.

3. *Lupus Exedens*, or the more deeply ulcerating form of the disease, may begin in two ways, with or without the existence of a tubercle on the skin. It is most commonly seated on the nose, beginning by ulceration of the mucous or muco-cutaneous surface, without any precursory tubercle, surrounded by redness of a violet or dusky hue, and attended by much inflammation, swelling, pain, and coryza. The ulcer is at first covered by a thick scab; as this separates, the sore extends, and often rapidly destroys

one or both alae, the tip and columna; after this the destructive action usually ceases for a time, the sore crusting over with greyish, hard, and adherent scabs: but, if not, it may go on eroding one half the face, producing a frightful rugged-looking cavity, and exposing and destroying the bones and large cavities of the face. I believe, however, that of these forms of disease, that which is limited to the nose, and that which extends widely over and through the face, essentially differ from one another. The first is generally of a *scrofulous* character, in fact consisting of strumous ulceration in one of the extreme parts of the body, the vitality of which is below its normal standard, and usually occurring in young persons, especially in women from eighteen to twenty-five years of age. Another form of this destructive ulceration is an extensive, deeply eroding, and fatal disease, affecting the whole of the soft tissues and bones of the face: it is distinctly of a *cancerous* character, and ought not, consequently, to be described as one of the varieties of lupus. The third variety is of *syphilitic* origin, being one of the most serious forms of tertiary syphilis.

The *strumous* form of lupus exedens, that which destroys merely the extremity of the nose, is commonly rapid in its progress, the part appearing to melt down under the disease, so that in the course of a few weeks the whole of the organ is destroyed. In other cases it is very slow, occupying perhaps many years, and partaking somewhat of the red and branny form of lupus non-exedens. Occasionally it is evidently associated with and dependent upon the syphilitic taint, and ought then to be considered rather as a variety of local syphilis in a strumous constitution than as a distinct affection.

Microscopic Structure.—It is not often that we have an opportunity of examining microscopically the structure of lupus. Some time ago, however, I removed by excision a patch of lupus non-exedens, which had existed for fourteen years under the chin of a woman aged thirty, who was otherwise in good health. On examination, it was found to be composed of large cells many times larger than blood-disks, having clear and very distinct cell-walls, and well-marked refracting nuclei. There were some cells, clear and globular, without nuclei; others were fusiform and elongated, with nuclei, evidently undergoing fibro-plastic transformation (Fig. 180). Molecular movement was very distinct in one of these globular cells. The mass of skin appeared to be converted into granular matter, intermixed with these cells.



Fig. 180.—Cells from Lupus.

The *Diagnosis* of lupus is not always easy, the disease being especially apt to be confounded with some forms of *impetigo*, with syphilitic tubercles and sores, and with cancer. From *impetigo* it may be distinguished by the absence of pustules, and of the thick gummy crusts characteristic of this affection, as well as by the less extent of surface implicated, and the deeper and more eroding form of the lupoid ulceration. From *syphilitic disease of the skin*, the diagnosis is not always practicable, inasmuch as true lupus may occur as the result of constitutional syphilis. In other cases, the history of the affection, the limitation of the disease, and the absence of intervening

secondary manifestations, make it easy to distinguish one from the other. From *epithelial cancer*, lupus cannot in some cases be distinguished; the two affections indeed being closely blended together, and being scarcely recognisable as distinct diseases.

The *Treatment* of lupus depends in a great measure upon the variety of the disease with which we have to do, and the constitutional condition attending it, and calls for the employment not only of local but of general remedies.

In *Lupus Non-exedens* we may, if the disease be limited, excise the patch and heal the sore that results by granulation. Not unfrequently, however, the cicatrix is apt to undergo fibro-vascular degeneration. If recourse be not had to excision, on account of the extent and superficial character of the disease, it is useless to attempt to destroy it by caustics. In every case in which I have seen these means tried, they have failed in effecting a cure. In some instances, however, the application of a strong solution of the nitrate of silver to the morbid surface will induce a healthier action; though in the majority of instances local applications of a soothing kind can alone be borne. Lotions containing glycerine are especially useful, as they prevent the surface from becoming dry and harsh. If the disease be situated on the face, care should be taken to avoid exposure to cold winds, dust, &c. In the *constitutional treatment*, the avoidance of stimulants of all kinds, the use of a bland diet, and the employment of some of the preparations of arsenic, will be found to be the most likely means to effect a cure. Indeed, arsenic may be considered the great remedy in this disease; the liquor arsenicalis, or the iodide in combination with small doses of biniodide of mercury, will be found extremely useful; Donovan's solution is also most beneficial in many instances.

In the treatment of the *Lupoid Ulcer*, the same constitutional remedies should be employed as have just been described, and a healthy action induced in the sore by the application of the chloride of zinc paste to the whole of its surface. The best mode of applying this is to keep the chloride prepared for use by being mixed with two or three parts of flour. When wanted, a sufficient quantity of this powder should be made into a stiff paste, by the addition of a little water, and then spread over the surface to be attacked by it, in a layer of about the thickness of a wafer; this should be left on for two or three hours, and then removed, the sore being covered with a piece of water-dressing until the greyish slough that has been produced has separated, when the caustic may be re-applied as often as necessary. Besides the chloride of zinc, various other caustics may be had recourse to, each of which possesses some peculiar advantages. The nitric acid is useful, if the action to be produced be not required to be very deep; for, as it hardens and coagulates the tissues to which it is applied, it does not consequently extend so far as the chloride. The acid nitrate of mercury presents the same advantage as the nitric acid and other fluid caustics—that it can be applied into the fissures and hollows of the part into which the more solid caustics do not penetrate, and is certainly useful in inducing a healthy action in the part, especially if there be a syphilitic taint. The potassa fusa and Vienna paste are useful, so far as their destructive properties are concerned, but are somewhat uncontrollable, and apt to spread. The most convenient mode of applying them is to cut in a piece of plaster a hole of the exact size and shape of the ulcer, to apply this around its borders, then to cover the sore with a layer of potassa cum calce, one line in thickness, and over this to lay on another piece of plaster. In this way a considerable amount of caustic action may be induced, which will be limited

to the exact surface to which it has been applied. Of all these caustic applications, however, I give the preference to the chloride of zinc; its action is more continuous, and appears to give a healthier stimulus to the part than any of the other agents.

The treatment of *Lupus Exedens* must have reference to the constitutional condition in which it occurs; if this be of a strumous character, the administration of cod-liver oil and the iodide of potassium, with a nourishing diet, will be most serviceable; in a syphilitic constitution, the remedies that are applicable to the cure of tertiary syphilis, such as the bichloride of mercury and Donovan's solution, are especially useful. In many cases also, in which there can be no suspicion of a syphilitic taint, these preparations of mercury, as well as the iodides of the same metal, may be administered empirically with great advantage. The liquor arsenicalis, or the combination of arsenic, iodine, and mercury that exists in Donovan's solution, or that is contained in a pill composed of one-sixth of a grain of iodide of arsenic and one-twelfth of a grain of biniodide of mercury, as recommended by Dr. A. T. Thomson, has appeared to me to be extremely beneficial, and in many cases certainly exercises a marked influence in arresting the disease. Whilst the patient is undergoing a course of these remedies, much attention requires to be paid to diet, clothing, and his general hygienic conditions.

In the local treatment, the first thing that requires to be done is to subdue inflammatory action and irritation, by leeches, emollient lotions, and opiate or henbane poultices. As this subsides, the progress of the disease will usually be arrested, for a time at least; and then, by the application of the nitric acid, chloride of zinc, or the acid nitrate of mercury, to the surface, a more healthy action may be set up, and the sore be made to cicatrize. Great mischief, however, will result if the caustics be applied too early, or if irritating ointments be used, as the destructive nature of the disease will then be augmented. The inflammatory redness and braun desquamation, resembling *lupus non-exedens*, that surround the ulcer, may usually most readily be made to disappear by the repeated applications of a strong solution of the nitrate of silver, which should be applied every second day by means of a camel hair brush. The cicatrix that forms in this disease is thin, and breaks readily, giving way on exposure to cold, or on the occurrence of constitutional derangement. The patient should, therefore, for some length of time after recovery, be careful not to expose himself to any such influences. In the more rapidly spreading and worst forms of *lupus exedens*, that horrible disease termed by the older surgeons "*Noli-me-tangere*," nothing can be done beyond the relief that is afforded by the administration of opiates, and a general sedative plan of treatment.

CANCER OF THE SKIN.—Cancer may occur in the skin as a true scirrhous or encephaloid deposit; most commonly, however, those affections of the skin termed cancerous consist of the epithelial form of the disease, and are usually seated about the lips, face, and scrotum, or at the orifices of the mucous canals; these we have already considered generally, and shall have to revert to them more fully when treating of the special affections of these parts. Some forms of *lupus*, also, may be of a cancerous character, but they do not exhibit the true evidence of malignancy by infecting the system, and giving rise to secondary deposits in the different viscera.

True cancer of the skin may occur in three forms: 1, as the Inlurated Wart of a scirrhous character, specially described by Scarpa; 2, as Scirrhous or Encephaloid Infiltration and Fungus; or 3, as Ulcers which, primarily originating from some local irritation of a simple kind, may, by the persistence of this, assume a truly cancerous character; thus I have seen the

scrotum and the neighbourhood of the apertures of fistule in perineo, in a case of old standing disease, become converted into a truly cancerous mass.

1. The *Scirrhus Wart* is usually of the natural colour of the skin, but sometimes of a reddish or dark-greyish hue, hard, and somewhat irregular in shape. It may remain for a long time stationary, but at last ulcerates and spreads rapidly, giving rise to vast destruction of parts; the ulcer formed by it presenting the characters of cancer, with a hard base, everted edges, and foul surface.

2. The *Infiltrated Cancer* of the skin occurs in the form of a flat dark induration, which scabs over with dark, rugged, greyish-brown incrustations, having shooting pains in and around it, and after remaining stationary perhaps for years, runs into ulceration, and rapidly destroys the parts affected; after ulceration has been set up, the patient's life, according to Dr. Walshe, is seldom prolonged beyond two years. *Encephaloid Cancer* of the skin is of rare occurrence, but occasionally forms large fungating masses sprouting from, and solely connected with, this tissue.

3. *Cancerous Ulcers* of the skin may arise from the irritation and contact of secretions, as of the urine; or an unhealthy and specific action may be set up in an old ulcer, as of the leg, and cause it to assume a cancerous character (Fig. 181). These cancerous ulcers may indeed occur upon almost



Fig. 181.—Cancerous Ulcer of the Leg

any part of the body: I have seen them on the back, breast, fingers, hand, thigh, and sole of the foot. They are flat, grey or sloughy-looking, often with warty granulations, a good deal of induration about them, and but little discharge.

The *Treatment* of cutaneous cancer consists in its excision, or in amputation of the part affected. Its removal by excision, whether in the form of wart, crust, or ulcer, should be effected as soon as its true characters have declared themselves, provided it be of such a size, and so situated, that it can be freely removed with a sufficient stratum of subjacent healthy parts, and a wide border of surrounding skin. Should it be so situated that its excision through surrounding healthy tissue is not practicable, amputation of the limb must be had recourse to, as was done in the case depicted in Fig. 181. Under such circumstances, the limb may be removed at no great distance above the disease; it not being necessary, as in other cases of cancer of the extremities where the bones are affected, to allow a joint to intervene between the seat of operation and the malignant growth.

CHAPTER XXXVIII.

DISEASES OF THE LYMPHATICS AND THEIR GLANDS.

INFLAMMATION OF THE LYMPHATICS.

Inflammation of the Lymphatics, Lymphatitis, or Angiulcitis, is a diffuse or erysipelatous inflammation of the lymphatic vessels. In it, according to Tessler, the lymph coagulates, forming a rosy clot, which obstructs the interior of the vessel; the walls of which, at the same time, become thickened, softened, opaque, and surrounded by a quantity of infiltrated cellular tissue.

SYMPTOMS.—This disease may be idiopathic, when it is closely associated with erysipelas; but more commonly it is set up from the irritation induced by an abrasion or wound. During the progress of an ordinary injury, the patient is seized with rigors, followed by febrile reaction, and attended, perhaps, by vomiting or diarrhoea. These symptoms often precede by twelve or fourteen hours the local signs of the disease, but more commonly accompany them. On examining the part it will, if superficial, be seen to be covered by a multitude of fine red streaks, at first scattered, but gradually approximating to one another so as to form a distinct band, about an inch in breadth, running from the part affected along the inside of the limb to the neighbouring lymphatic glands, which may be felt to be enlarged and tender. The band itself feels somewhat doughy and thickened. There is usually more or less œdema of the limb, from the implication of the deeper layers of vessels and their obstruction by the inflammation. Along the course of the inflamed absorbents, erysipelatous-looking patches not unfrequently make their appearance, which coalesce until they assume a considerable size, and constitute a distinct variety as it were of erysipelas. In some cases the glands are affected before any other local signs manifest themselves, owing probably to the deeper seated lymphatics having been first implicated; and not uncommonly throughout the disease the inflammation continues to be confined principally to this set of vessels, giving rise to great and brawny swelling of the limb, but without much if any superficial redness. The constitutional disturbance, at first of the active inflammatory type, may gradually subside into the æsthenic form.

RESOLUTION.—The disease usually terminates in resolution at the end of eight or ten days; not uncommonly it runs on to erysipelas; and in other cases, again, limited suppuration may take place, or a chain of abscesses may form along the course of the inflamed absorbents and in the glands to which they lead. In some instances, after the disappearance of the disease, a state of chronic and rather solid œdema of the part may be left, giving rise indeed to a species of false hypertrophy of it, and constituting a troublesome consequence; more rarely, death results either from erysipelas, from the supervention of pyæmia, or from the occurrence of secondary abscesses. This is chiefly in broken constitutions, in which the disease has made extensive ravages, and has become associated with low cellulitis.

DIAGNOSIS.—The diagnosis of inflammation of the absorbents is easy; the only affections with which it can be confounded being erysipelas and phlebitis. From erysipelas it may be distinguished by the streaked character and limited extent of the redness, though, as the two affections so commonly occur together, the distinction is of little moment. From phlebitis, the

disease we are now considering may be recognised by its superficial redness, the inflammation of contiguous glands, and the absence of the knotted corded state, characteristic of an inflamed vein.

CAUSES.—The causes of inflammation of the absorbents closely resemble those of erysipelas; the disease being especially disposed to by atmospheric vicissitudes, by particular seasons of the year, more especially the early spring, and by the epidemic constitution at the time tending to disease of a new type. So also, the broken health of the patient and the neglect of hygienic precautions tend to induce it. Amongst the more direct causes are wounds of all kinds, but especially such as are poisoned by the introduction of putrid animal matters or other irritants, or that are of recent origin. It is very rarely indeed, that inflammation of the absorbents occurs without some such cause; yet I think we are warranted in considering it as of idiopathic origin in some instances. I have at least seen cases in which careful examination has failed in detecting any breach of surface, or evidence of poisonous absorption.

TREATMENT.—This consists in the employment of antiphlogistic remedies such as the application of a series of leeches along the course of the inflamed absorbents, followed by assiduous poppy fomentations; the limb at the same time being kept elevated. The bowels should be freely opened; and, if there be much pyrexia present, salines with antimony may be administered. If the fever assume rather a low form, the liquor ammoniæ acetatis may be given in camphor mixture; support being administered or withheld, in accordance with the principles laid down when speaking of the treatment of inflammation generally. If chronic induration and œdema occur, the application of blisters will be found to be of use in taking down the swelling and hardness; bandaging, so as to compress the limb methodically, may be of service in the later stages. If abscesses form, these should be opened early, and treated on ordinary principles.

INFLAMMATION OF LYMPHATIC GLANDS.

Inflammation of the Lymphatic Glands, or Adenitis, may occur either from the extension of inflammation along the course of the lymphatics, from the irritation induced by acrid or poisonous substances conveyed along these vessels, and not inflaming them, but inducing diseased action in the glands through which they are carried; or as a consequence of strains resulting from over-exertion, as is often seen in the glands of the groin from walking too much. In whatever way occurring, inflammation of the absorbent glands is always attended by a stasis of the lymph, by coagulation of it, and, if the whole or greater part of the glands of a limb be affected, the course of the fluid through the absorbent vessels may be so seriously interfered with, that œdema, often of a solid character, occurs in the lower parts from which the lymph ought to have been conveyed.

VARIETIES.—Adenitis may be acute, subacute, or chronic. In *Acute Adenitis*, which almost invariably occurs as a consequence of angioleucitis, there are pain, swelling, tenderness, and stiffness about the affected glands, with a dull, heavy sensation in them, followed by all the signs of acute abscess, the glands gradually softening in the centre, and the suppurative inflammation extending to the contiguous cellular membrane, through which it becomes somewhat diffused. In the *Subacute Adenitis*, which is of common occurrence as a result of injuries or strains, the glands become swollen, enlarged, and tender, and are matted together by the inflammatory and plastic consolidation of the neighbouring tissues. If abscess form, it commonly commences in the first instance in the structure around the

glands; and these are perhaps eventually exposed at the bottom of the cavity that results. This is especially apt to happen in cachectic and strumous persons from slight sources of irritation. Very commonly, in such subjects as these, the inflammation of the glands runs into a *Chronic* state; which, indeed, may at last terminate in their permanent enlargement and induration, or in tuberculous degeneration. When the glands become chronically inflamed from the first, they will be found to be enlarged and hardened, with tenderness and pain about them: after a time suppuration takes place within them; or perhaps it may occur in the cellular tissue around them, which, breaking down, leaves them in the form of reddish-grey or fleshy masses, that protrude in the midst of the suppurating cavity: as the inflammation subsides, the skin becomes of a reddish-blue or purple hue, is thinned, and firmly incorporated with the subjacent tissues.

Strumous Enlargement of Glands.—The glands not uncommonly enlarge *chronically* without inflammation, simply as the result of strumous disease or of chronic irritation of some kind. They may remain permanently enlarged, or, after continuing so for months or years, may slowly break down into unhealthy suppuration, leaving the skin thin, blue, and undermined, with weak and often protruberant cicatrices. The pus is curdy and ill-conditioned. In all probability, the peculiar enlargement and tendency to unhealthy suppuration arise from the deposit of tuberculous matter within the gland. These changes principally occur in the neck, especially in the submaxillary glands and the glandula concatenatae, sometimes in the axillary or inguinal glands, forming large indurated and nodulated tumours matted together, and suppurating in the interstices of the cellular tissue, or in the substance of the glands themselves. This strumous enlargement of the glands occurs chiefly in children and in young people; in whom, indeed, it is commonly looked upon as one of the most frequent accompaniments of the strumous diathesis.

TREATMENT.—The treatment of inflamed absorbent glands varies greatly, according to the stage of the affection. In the *acute stage*, leeches and fomentations are especially required. In the *subacute* condition, spirit-lotions containing the iodide of potassium will subdue the inflammation and take down the swelling; at the same time, the health must be regulated by aperients, and a moderate antiphlogistic plan of treatment. If abscess form, it must be opened with a knife, and the part well poulticed afterwards; the fistulous openings, which are often left, require to be treated by stimulating applications, especially the nitrate of silver, but very commonly they will not heal unless they are slit up and dressed from the bottom.

Chronic inflammation or enlargement of the lymphatic glands, or the induration left as the result of the acute disease, require to be treated on different principles. If there be any pain and tenderness about them, the application of the iodide of potassium and spirit-lotion will be required. If they have already suppurated, and an aperture exist leading down to an indurated mass, or if there be surrounding induration of the soft tissues, it is often a good plan to rub the ulcerated part freely with caustic potass, which will dissolve it away by exciting inflammation around the plastic deposit, and thus causing its dissolution into pus. When there is merely chronic enlargement, without irritation, methodical friction with iodine or iodide of lead ointment will produce absorption of the inflammatory effusion constituting the bulk of the enlargement; and this in many instances may remove the tumour entirely. In other cases, painting the part with the tincture of iodine, and improvement of the general health, will cause the

removal of the diseased structure. After abscess has formed and been opened, fistulous openings will be left, into which large masses of hyperplastic gland may be seen to project. These are best reduced by the red oxide of mercury, or potassa fusa; indeed, if the glands be much enlarged and indurated, projecting into the openings made over them, the potassa fusa is the best application that can be made use of, breaking down and dissolving away the indurated mass. In applying it, care must be taken that the caustic do not spread too widely; this may usually be attained by coating the surrounding integuments with collodion. Extirpation of enlarged lymphatic glands is seldom necessary, and, if undertaken, may lead to more serious and extensive dissections than might appear at first requisite for a chain of diseased glands often extends to a considerable distance, and after one has been removed, others come into sight. As a general rule, the operation should not be undertaken: cases, however, occasionally occur, in which such a procedure may be deemed advisable, the affected glands being large, indurated, and tuberculous, and their disease of many years' standing; their extirpation may then be proper, and I have not unfrequently had occasion under such circumstances to remove them from the axilla, from the submaxillary region, and from the posterior triangle of the neck.

The lymphatic glands occasionally become much enlarged in the neck, axilla, and groin without any indications of struma, but attended by much debility, and usually great emaciation; under these circumstances, the best remedies are liquor potassæ in full doses, iodide of iron, and cod-liver oil.

OTHER DISEASES OF GLANDS.—Besides these inflammatory and strumous enlargements of the lymphatic glands, various other alterations are frequently observed in them: thus, they may undergo *Cancerous Degeneration*, as the result of absorption from a scirrhus, melanotic, or encephaloid tumour. In other cases, again, they have been found to have undergone *Calcification*, as the result of tuberculous degeneration; and lastly, a *Fungous Condition* of the absorbent vessels that pass through them has been observed by Amussat and Breschet: but these are matters of pathological rather than of practical interest.

CHAPTER XXXIX.

DISEASES OF VEINS.

PHLEBITIS.

Inflammation of the Veins, originally studied by Hunter, has of late years attracted the attention of many distinguished Continental and British pathologists, amongst whom may be especially mentioned Breschet, Velpeau, Cruveilhier, Arnott, Lee, and Tessier. This disease is commonly excited by the wound of veins, as in operations, venesection, and injuries of various kinds; or may result from the application of ligatures to them; and it is especially predisposed to by a previously unhealthy condition of the blood, by epidemic constitution, and by season—in fact, by those influences that dispose generally to the low and diffused forms of inflammation.

PATHOLOGY.—When a vein is inflamed, important changes occur both in the coats of the vessel and in the contained blood. The coats of the vessel

generally become thickened, the outer one especially being vascular and infiltrated; the inner coat becomes softened, pulpy, and usually more or less stained by the colouring matter of the blood of a dark-red or purple hue. The blood in the inflamed vessel coagulates, and adheres to its sides; this tendency to adhesion and conglutination being increased by the effusion of plastic matter from the wall of the vessel. As a consequence of this, its interior becomes stuffed with a mass of coagulated blood and lymph; sometimes solid throughout, in other cases somewhat tubular, the central hollow being either free or filled with soft blood-coagulum. This coagulation in the interior of the inflamed vein is a very remarkable circumstance, and appears to be specially induced by the morbid action going on in the coats of the vessel; though in many cases it is doubtless aided by the blood becoming entangled in the plastic matter with which the lining membrane of the vein speedily becomes coated. Suppuration often takes place in the interior of the vein—the pus being produced, not by the transformation of the contained blood, but by effusion from the coats of the vessel. These changes may occur in any vein, external or internal, and we often find them associated—the same vessel containing a mixture of coagulum, fibrine, and pus. The extent of surface which the inflammation may occupy varies from that of a small vessel a few inches in length, to the trunk and branches of one of the largest veins in the body. In accordance with those pathological conditions, three varieties of phlebitis may be described—the Adhesive, the Suppurative, and the Diffuse.

ADHESIVE PHLEBITIS.—Plastic matter is thrown out by the wall of the vein; and the blood coagulating upon and in this, a firm plug is formed, by which the vessel is more or less completely obstructed. This obstruction of the vessel, which is the common result of this form of the disease, may continue permanently; the plug becoming incorporated with its coats, and gradually undergoing fibro-cellular degeneration, the vein is converted into an impervious cord. In other cases, a channel eventually forms through the axis of this coagulum, allowing the circulation through the vein to be re-established.

Symptoms.—In the adhesive phlebitis the action is usually localised and limited; very commonly it arises from traumatic causes, and not unfrequently is subacute. When traumatic, it may occur in any vein that is wounded; but when idiopathic, it commonly occurs in those situated in the calf or leg, especially if they be varicose. The inflamed vein is hard, swollen, knobbed, and painful, the knobs constituting distinct enlargements opposite to the valves; if superficial, it presents a reddish-purple colour; and there is some degree of stiffness and of inability to move the limb. There may perhaps be no pain, but only deep tenderness over the course of the vessel. There is always some oedema around the inflamed vein, and in the part that supplies it with blood. This oedematous condition of the limb is a most important diagnostic sign in deep-seated adhesive phlebitis when the vein cannot be felt (as in the pelvis, for instance), and may perhaps be the first symptom observed, coming on either suddenly or gradually. The oedema may give rise to a hard, white, and tense condition of the limb, which pits on pressure, though in some cases the hardness is too great for this. Occasionally, in deep phlebitis, the limb may suddenly swell to a considerable size without there being any subcutaneous oedema. In a case of phlebitis of the deep veins of the leg and thigh, once under my care, the calf of the affected limb suddenly enlarged, with great pain and much distension of the subcutaneous vessels with fluid blood, but without any subcutaneous oedema. As the inflammation subsides, the swelling of the limb goes down, the circu-

lation passing through its former channels, or the blood being carried off by the collateral venous system. If suppuration occur, no change takes place in the symptoms so long as the pus is localised or encysted, unless it perforate the coats of the vein, and, passing into the external cellular tissue, forms a common abscess. If it break through its plastic barriers, however, then a very different result occurs, and the symptoms of purulent infection come on. The *Constitutional Disturbance* in this form of phlebitis is often of a very mild character; if, however, suppuration occur, symptoms of well-marked pyrexia manifest themselves.

The *Treatment* of adhesive phlebitis consists in the free application of leeches along the course of the inflamed vessel, with rest of the limb, and fomentations; at the same time salines and purgatives must be administered, and recourse be had to the ordinary antiphlogistic means. If depression come on, carbonate of ammonia must be early given. The hardness, which is often left after the removal of the inflammation, may usually be got rid of by salt and nitre poultices, as recommended by Dr. Basham. If abscesses form, they must be opened whenever they occur. If oedema of the limb continue, the application of blisters, or the pressure of an elastic roller, will remove this troublesome symptom.

SUPPURATIVE PHLEBITIS is always preceded or accompanied by the adhesive form of the disease; the adhesive action bounding and limiting the suppuration, and preventing the pus from becoming mingled with the current of the blood. In this form of the disease, the pus is usually found between the coats of the vessel and the plug, or in a portion of the vessel unoccupied by coagulum, but confined at each end by a mass of plastic matter. If the plastic plug be insufficient to occlude the vessel, or if it become absorbed or metamorphosed into pus, then this fluid may get access to the general circulation, and produce that serious and fatal train of symptoms constituting pyæmia, and depending on the admixture of pus with the blood. Pus has been described as forming in the centre of the coagulum, at a distance from the coats of the vessel; but Guilliver has pointed out the error of this, by showing that in many cases the fluid described as pus is merely disintegrated fibrine.

DIFFUSE PHLEBITIS is an erysipelatous form of the disease, often running for a considerable distance along the coat of the vein, which becomes thickened, pulpy, and red, without adhesions forming or the blood coagulating; indeed, in cases of this kind there appears to be a great want of plasticity in that fluid. This form of phlebitis is commonly, though not always, fatal: its fatality was supposed by Hunter to be owing to the extension of the inflammation to the heart, and by Hodgson to the extent of surface affected; but Arnott has shown that the inflammation scarcely ever reaches the heart, and that the extent of vein inflamed is commonly very limited—it not unfrequently happening that the disease proves fatal when but a few inches are affected, as in the vessels of a stump. Hence it is probable that death is owing either to the admixture of pus with the blood that circulates through the inflamed portion of the vein, or to such changes, induced in the blood by the inflamed surface over which it passes, as are incompatible with life.

Symptoms.—The diffuse phlebitis is ushered in by the ordinary symptoms of pyrexia, at the same time that pain and tenderness, with a certain amount of oedema and hardness, may manifest themselves along the course of the inflamed vessel. These symptoms, however, speedily give way to those that characterise the lowest forms of ataxic fever—such as a fluttering pulse, a brown tongue, sordes about the mouth and teeth, with much anxiety of countenance, diarrhoea, vomiting, extreme prostration, delirium, and death.

These symptoms are, indeed, due to the formation of pus in the vein, its admixture with the blood, and consequent poisoning of the system. The whole danger and peculiarity of diffuse phlebitis depend, I believe, upon this circumstance; and I would, therefore, refer for the consequences and treatment of this form of the affection to the chapter on Pyæmia (p. 461).

The essential difference between these three forms of phlebitis would appear to depend on the formation and situation of the plastic matter. So long as the inflammation is purely adhesive, or as the pus formed by it is bounded by adhesive plugs, it does not differ in its effect from ordinary inflammation; but if the pus enter the circulation through the breaking-down or disintegration of these limiting plugs, or if the blood be deeply and seriously altered in its characters by changes induced in its passage over the inflamed surface, then we meet with those peculiar phenomena, indicative of general blood-poisoning, which have been described as pyæmia.

VARIX.

By *Varix*, or *Varicose Veins* is meant a dilated condition of these vessels, with hypertrophy of their coats, giving rise to oedema, tension, weight, and pain in the parts they supply—often with a good deal of numbness, difficulty in motion, or loss of power in the affected limb. In other cases, their pressure on the nerves of the part (as when the veins of the spermatic cord are enlarged) may give rise to very severe suffering.

APPEARANCE.—Varicose veins are tortuous, dilated, and sacculated; they are serpentine in their course, and feel thick under the finger. They may be superficial or deep-seated; when superficial, the disease is often limited to one of the larger venous trunks of a limb, the smaller branches not being engaged. This we commonly see to be the case in the internal saphena; in other cases, the small cutaneous veins alone may be affected, appearing as a close network of a purplish-blue colour under the skin, with much discoloration of parts, and some oedema of the limb; or both sets of vessels may be implicated. The deep-seated varix is not by any means so common as the superficial; and, when it occurs, is generally the result of the pressure of a tumour, or of some similar cause. Varicose veins, especially when superficial, are very apt to inflame, with coagulation of the blood within their sinuses.

LOCALITY.—The veins of the skin and mucous membranes are those that are most liable to this affection. It is most commonly met with in the legs, and more particularly in the trunk of the internal saphena; but any of the superficial veins, as of the arms, chest, head, neck, hypogastrium, or thorax, may be affected. The veins about the anus are especially liable to varix, constituting some forms of pile; so, also, the spermatic veins very often become enlarged, constituting varicocele. As a general rule, superficial varix is infinitely more common in the lower than in the upper part of the body, owing evidently to the tendency to the gravitation of blood in the more dependent situations. When occurring at any point above the pelvis, it may be looked upon as arising, in all probability, from the pressure of a tumour of some kind upon the large venous trunks. The deep-seated veins that are principally affected are—the internal jugulars, the vena azygos, and the veins of the prostate.

CAUSES.—The causes of varix are generally such conditions as induce more or less permanent distension of the veins. Thus, for instance, blows, strains, and habitual over-exertion of a part, by driving the blood into the subcutaneous veins, may give rise to their distension; so also, certain occupations may favour gravitation of blood to the lower part of the body; then, again,

the length of a vein, as of the internal saphena, may occasion its dilatation by the weight of the long column of the contained blood. Any obstacle to the return of the blood from a vein (as the pressure of a tight garter below the knee, or of a tumour upon one of the large venous trunks) may give rise to its permanent distension, as well as to that of all its branches. In other cases the affection, or the disposition to it, appears to be *hereditary*; and in many instances it is difficult to recognise any cause except an *enfeebled and relaxed state of the walls* of the vessel, such as is met with in tall, debilitated, and phlegmatic people. Age influences materially the occurrence of the disease, which is rare in the earlier periods of life, but gradually increases as the individual advances in years. In women, especially, the affection is common; in consequence, partly, of natural debility, but more frequently from the pressure of the enlarged uterus during pregnancy.

STRUCTURE.—Varicose veins are sometimes simply dilated, without any thickening of their coats; but in other instances they are truly hypertrophied, their cavity being dilated and walls thickened—the vessel likewise being elongated, forming curves, and bending back on itself. Sometimes the enlargements at particular points appear to be multilocular, the vein forming a series of curves and dilatations together. The valves are always insufficient in varicose veins, being usually bent backwards or ruptured; and the lining-membrane is marked by longitudinal striae. The blood in these vessels has a tendency to coagulate in large masses, the vein being at times the seat of inflammation, by which this tendency is materially assisted. The neighbouring and subjacent parts are much modified in structure; and there is usually chronic oedema, with infiltration of the skin and cellular tissue, which may at last run into ulceration—giving rise to the varicose ulcer, which has already been described (p. 425), and which, if communicating with a large branch, may yield a copious or even fatal hemorrhage. The blood contained in the varicose knots and veins becomes more or less stagnant, and probably altered in its qualities, so as to render the vessels peculiarly liable to inflammation, and possibly even to influence the state of the general health to a material degree.

TREATMENT.—This is of a palliative and a curative kind. The *Palliative Treatment* consists in moderate compression exercised upon the vessel, so as to support its weakened and dilated coats, and thus prevent its further distension and the pain occasioned by this, as well as the other consequences—such as oedema, disorganisation, and ulceration of the skin. The pressure must be applied very smoothly and evenly, lest it irritate and ulcerate the skin, or produce distension of the vein below the part compressed. For the purposes of compression, bandages and elastic stockings are commonly employed. I know of no better material for this purpose than Churton's elastic bandages; and I have in many cases used Huxley's stockings, made of an elastic woven material, with great advantage. In some cases, elastic pressure by means of a vulcanised India-rubber band or garter may be applied around the limb, so as to simulate the action of the valves of the vein; by compression it cuts off the weight of the column of blood from the terminal branches. In other cases, the application of a *truss* to the upper part of the saphena vein, as recommended by Colles, may be of service.

If a varix burst, violent bleeding may suddenly take place so as to induce faintness, and even death. The copiousness of the bleeding may be accounted for by its occurring from the *cardiac* side of the varix, the insufficiency of the valves not presenting the ordinary obstacle to the downward

flow of blood. The treatment consists in laying the patient flat on the floor and raising his leg, when the hemorrhage will cease. It may be permanently arrested by the pressure of a compass and bandage.

Under certain circumstances it becomes necessary to change the palliative for a curative plan. This is especially requisite under the following three conditions:—1, If the varix be of such large size as to produce much inconvenience, or to give rise to severe pain by its pressure on the nerves in its neighbourhood; 2, if a varicose vein have burst, or be on the point of giving way; or 3, if an ulcer dependent on its existence will not heal. Under one or other of these circumstances, it may be necessary to have recourse to curative treatment. With this view various plans have been recommended; all of which, however, have for their object the production of obliteration of the vein at one point by exciting adhesive inflammation there, and thus causing it eventually to degenerate into a fibro-cellular cord. In this way the trunk of a varicose vein and the larger masses of varix may be occluded. But can the disease be cured by the local obliteration of the vein? To this question I have no hesitation in answering in the negative. Though the trunk be obliterated, a collateral venous circulation is set up, which is very apt in the course of a few months to take on a varicose condition, and thus to cause a return of the disease some time after the operation. But, though the cure be not radical, much benefit may often be effected by removing varicose knots that occasion pain or inconvenience, by enabling an ulcer to cicatrize, or by occluding a vein from which hemorrhage has occurred. The principle of all curative treatment in varix consists in exciting adhesive and localised inflammation in the vein so as to occlude it, and thus, by directing the blood into other channels, to relieve the distension of the diseased vessels and the inconvenient results that follow this. As the treatment thus necessarily involves the artificial excitation of phlebitis, there is always some little risk of the inflammation passing beyond the adhesive stage into that of suppuration, or diffuse inflammation: but out of upwards of 200 cases, in which I have performed these operations, not one has died.

Various plans for obliterating the veins have been recommended by surgeons. They resolve themselves into four principal heads of treatment.

1. The *subcutaneous section* of the vein, or the *excision* of an inch or so of the vessel. This plan of treatment is severe, and not unattended by danger, as we learn from Sir B. Brodie.

2. It has been recommended by Mayo, Seutin, Bonnet, and others, to *excite inflammation in the vein* by producing a series of deep eschars or issues in the skin covering it, by the application of a caustic, such as chloride of zinc or potassa fusa. Mr. Skey speaks very favourably of this mode of obliterating varicose veins, as being devoid of danger. He recommends the eschars to be made by the application of a powder, composed of three parts of lime and two of potass, made into a paste with spirits of wine at the time of application. The eschars should not be larger than a split pea, and their number must depend on the extent of the disease.

3. Others recommend the obliteration of the vessel by *introducing needles into it, and transmitting a galvanic current* along and across them. Of this plan of treatment I have not had any experience; nor do I believe that it is ever employed by surgeons in this country.

4. *Injection of the varix by a few drops of a solution of the perchloride of iron*, as recommended by M. Pravaz, is a very effectual method of procuring coagulation of the contained blood and consolidation of the varix, more particularly if it be of a very large size and cellular. In employing this

means it is better to compress the vein, by means of the finger or a pad and bandage, above the varix; the solution is then to be injected in very small quantity—not more than three or four drops—by means of the syringe (which will be described in speaking of the treatment of *nævus*), into the dilated veins. Coagulation of the blood immediately takes place. The patient must be confined to his bed for a few days with the limb raised, and a bandage should be applied before he is allowed to walk about. This means is very effectual in large varix, and may in such cases be advantageously conjoined with the next method—the pins being used under the venous trunks, and the solution introduced into the dilated masses of the varix; but it is not devoid of danger. Accidents, such as local suppuration and sloughing, and even pyæmic symptoms, have followed its use.

5. The most convenient and safest way of obliterating the vein in my opinion, and that which I always employ, consists in compressing the vessel at several points, by *passing a hare-lip pin underneath it*, laying a piece of wax-bougie over it, and then applying the twisted suture around the pin and

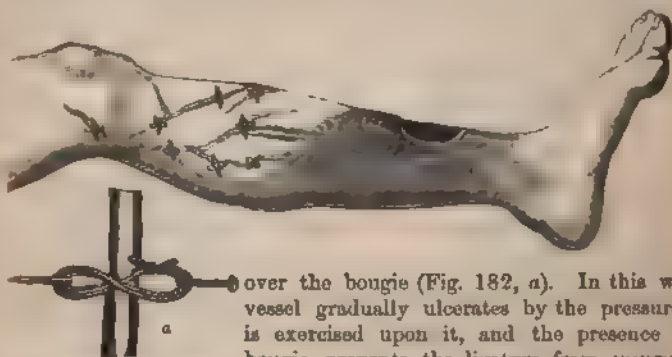


Fig 182.—Application of Pins to Varicose Veins.

over the bougie (Fig. 182, a). In this way the vessel gradually ulcerates by the pressure that is exercised upon it, and the presence of the bougie prevents the ligature from injuring the skin. In performing this operation, care must be taken that the vein be not transfixed, but that the pin be pushed, or rather dipped, underneath it; the ligature should not be too thin, and must be applied tightly over the bougie; several pins (as many as eight or ten, if necessary) should be introduced along the course of the same vessel, at distances of about three-quarters of an inch from one another (Fig. 182); those highest up should be put in first, and they should be left in for at least a week or ten days, by which time the obliteration of the vessel will have taken place. I believe that all the danger of the operation consists in the transfixion of the vein by the pin; the operator may always know when he has done this by the escape of a few drops of venous blood; when the pin is properly passed under the vein, the operation is a perfectly bloodless one. If the vein be transfixed, the pin should immediately be withdrawn and passed at another point; if it be allowed to remain in the vein, it will act as a foreign body, and suppurative phlebitis will ensue. When the vein is properly compressed between the pin below and the bougie above, adhesive inflammation takes place in it, and it becomes obliterated at the point of pressure. By attention to these circumstances I have never met with any ill-consequences, either from suppurative phlebitis or pyæmia, in any of the cases in which I have performed this operation, which are between 200 and 300 in number.

In addition to the application of the pins in the usual way, Mr. Lee has recommended the subcutaneous division of that portion of the vein which is

included between them, after coagulation of the blood has taken place. This I have found to be an useful addition to the ordinary treatment, and to insure the obliteration of the vessel.

The points of the pins may be prevented from pressing injuriously upon the skin, by putting small pieces of adhesive plaster under them. The powers of the constitution should at the same time be improved, and the activity of the circulation kept up by nourishing diet, tonics, and wine. Whilst the pins are in, the patient must not be allowed to move about, and after they have been taken out the limb should be bandaged for some time. In general no ulceration takes place about the pinhole apertures; but occasionally, in debilitated constitutions, a sore forms, which requires to be treated on ordinary principles.

CHAPTER XL.

DISEASES OF ARTERIES.

ARTERITIS.

CAUSES.—The causes of inflammation of arteries, or *Arteritis*, are extremely obscure. In many cases it arises from constitutional causes, with the nature of which we are as yet unacquainted; in the majority of instances, however, it is distinctly of traumatic origin, occasioned by the wound, rupture, or ligature of an artery.

Arteritis occurs under two distinct forms; as the *Adhesive* or *Limited*, or as the *Diffuse* or *Erysipelatous*. Adhesive arteritis may either be of an acute or of a chronic character, and may be idiopathic or traumatic in its origin. Diffuse arteritis invariably arises from injury or ligature of the vessel.

ADHESIVE ARTERITIS.—Both the coats of the vessel and the contained blood undergo important alterations. In the simplest form, arising for instance from the pressure of a tumour upon an artery, the coats are thickened and fused together, as it were, so as to form an impervious cord; in the more acute forms of the disease, the sheath and the external coat become pulpy and vascular, with effusion of plastic matter in and around them. The middle coat does not undergo any primary change, but after a time becomes contracted, thickened, and somewhat softened. The internal coat becomes softened, pulpy, and stained by imbibition of the colouring matter of the blood. In consequence of these changes in the coats, the vessel loses its elasticity and becomes brittle. After the inflammation has existed a short time, a plug is deposited in the diseased part of the artery; this plug assumes two distinct forms. It may be deposited as a membranous layer of decolorised fibrine, occluding the orifices of collateral branches (Fig 183); but most frequently it is deposited in the form of a conical plug, which completely blocks up the vessel at the part

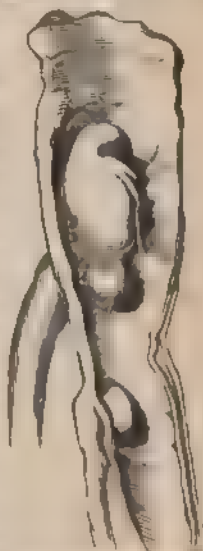


Fig 183.—Plastic Deposit in Aorta.

inflamed, below which the calibre of the artery is somewhat contracted (Fig. 184). The plug is formed of two distinct materials. The upper



Fig. 184.—Plastic
Plugs occluding
the Axillary
Artery, and oc-
cluding Gang-
rene of Hand
and Arm.

and lower parts consist of a mass of a yellowish or reddish colour, composed of inflammatory exudation-matter, intermingled with fibrine deposited upon it by the circulating blood, and adhering firmly to the contiguous walls of the vessel. The upper portion of the plug is black, and consists of simple coagulum, deposited upon and tailing on to the decolourised mass; it is usually long, narrow, and stumpy, and is not adherent to the sides of the vessel. The plug may continue permanently to block up the artery, which gradually contracts upon it so as to be eventually converted into a fibro-cellular cord; or it may be partly absorbed, channelled through the centre; or lastly, it may be entirely removed by absorption, the calibre of the vessel being fully restored.

DIFFUSE ARTERITIS.—The morbid appearance extends more widely, spreading along the coats of the artery to a considerable extent; there are redness, of a deep claret colour injection, and thickening of the coats, a loss of the physiological properties of the vessel, and an absence of all plastic exudation.

SECONDARY EFFECTS.—These are of great importance.

Arteriation, or even **occlusion**, of the interior of the artery not unfrequently occurs, as a consequence of inflammation of the vessel. This usually results from chronic arteritis, often excited by the pressure of a tumour or of some other local irritant. As it is usually a slow process, there is abundant time for the anastomosing circulation to be set up; so that the vitality of the limb, or part supplied by the diseased vessel, is preserved. The artery that has been so narrowed and closed, ultimately becomes converted into a cellulo-fibrous cord up to the nearest collateral branch, just as if it had been occluded by a ligature.

The plug which renders the vessel impervious by obliterating it, may in some cases give rise to *gangrene* of the parts supplied. This is especially apt to occur if the arteritis be acute, if the patient be aged, or if the plug be so situated as to occlude some of the principal anastomosing branches, so that there may not be time or opportunity for the collateral circulation to establish itself. In other cases, plastic matter may not only be deposited at the part inflamed, but may even be carried lower down than the original seat of disease, and thus accumulate in the terminal branches of the artery. The vessel will thus be obstructed at two points, between which a pervious part will be included. This double occlusion of the vessel, I believe, renders *gangrene* of the limb inevitable; at least, in all those cases in which I have seen mortification result from arteritis, this condition has existed.

The plastic matter poured out at the inflamed point may in some cases be carried on through the terminal branches of the vessel into the capillaries, and thus, entering the general circulation, may form buff-coloured deposits in various organs, especially in the spleen. In other cases, again, it may be carried into the veins, giving rise there to *phlebitis* and to other similar conditions.

SYMPTOMS.—The *Local Symptoms* of arteritis depend not only on the condition of the vessel itself, but on that of the parts which it supplies. There are pain; some tension and stiffness of the affected limb; a good deal of tenderness; and a cord-like feeling along the inflamed vessel, in which also a jerking and forcible pulsation can be felt. The pain below the part of the artery that is inflamed, is always of a very severe character, and is distinctly of two kinds—superficial and deep. The *superficial* pain is seated in the skin, which is excessively sensitive to the touch, so that the patient cannot bear the finger to be laid upon it, just as is the case in neuralgia; it is of a smarting and pricking character, and is, I believe, always associated with more or less loss of muscular power. The *deep* pain is of a burning and lancinating character, and not only follows the course of the vessels, but strikes through the limb in different directions. If the inflamed part of the vessel be not completely occluded by the plastic plug deposited in it, the pulsation in the arteries of the limb, below the seat of the disease, may continue much as usual; but in the majority of cases the pulsation ceases in all the vessels on the distal side of the inflamed spot, and the limb gradually loses its temperature, becoming of a dark or livid colour, and cold; but yet the inordinate sensibility of the surface continues. As the gangrene advances, however, this is lost; the parts, at the time that they lose their sensibility, assuming the ordinary characters of dry, shrivelled, or mummified gangrene, until all indications of vitality cease. If, however, the veins be inflamed, as well as the arteries, the dark moist variety of mortification will result. It is in this way that some of the so-called “spontaneous gangrenes” are occasioned (p. 430).

The *Spontaneous Gangrene* resulting from arteritis may occur in the upper as well as in the lower extremities, and is not unfrequently met with in young people; at least, in most of the cases in which I have seen it, it has occurred in individuals under the age of thirty. When it is the result of pure arteritis, independent of any other structural affection of the coats of the vessel, the gangrene, I believe, most commonly occurs in the upper extremity. Arteritis, however, is by no means necessarily followed by mortification; the liability to the loss of vitality depends on the seat of the inflammation, being greater when it takes place in the neighbourhood of the large collateral trunks of the limb, and when it is of an acute character, so that the anastomosing circulation has not time to establish itself. It also occurs more frequently when the arteritis is idiopathic than when it is traumatic; as then a larger extent of vessel is plugged, and there is a greater tendency to the occlusion of those important collateral branches by which the vitality of the limb is ultimately to be preserved. The clogging of the terminal branches, by the plastic matter poured out at the seat of inflammation and washed down into the lower part of the limb, is a powerful cause of gangrene. Those arteries the inflammation of which most commonly terminates in this way are the iliac and the axillary; and it is not uninteresting to observe that the cause of danger in this disease is the very condition that gives safety in phlebitis, viz., the plugging of the vessels with plastic matter—embolia (p. 430).

The *Constitutional Symptoms*, which in the local limited adhesive arteritis are in the first instance of an inflammatory kind, speedily sink into the ataxic form as gangrene comes on. In the diffuse arteritis, the asthenic fever sets in early, and speedily destroys life.

TREATMENT.—The treatment of acute arteritis must be conducted on general principles. Leeches should be applied to the part, and perhaps blood taken from the arm; calomel and opium may then be administered: but as a

general rule I would prefer the exhibition of those salines, such as nitrate the acetate of potass in large doses, which we know by experience to possess considerable influence in the solution of fibrinous deposits. When gangrene has supervened, we must wait for the line of separation before recourse is had to amputation, as the disease must be looked upon as being of constitutional origin.

STRUCTURAL DISEASES OF ARTERIES.

An artery may be the seat of various structural lesions, which play an important part, not only in giving rise to ulterior diseases in the vessel itself, but in disposing to various affections of the organs which it supplies. If we look on an artery as a tube composed of tissues that differ largely in their organisation and structure, we must necessarily consider their diseases to be equally varied; and we shall find that, whilst the changes which take place in the external or cellular coat, in which the whole of the vital or nutritive activity of the vessel resides, are chiefly conservative, those that have their seat in the internal and middle coats have a destructive tendency. This important difference in the character of the diseases of the coats of the vessel, is dependent on the relative degrees of vascularity and of vitality possessed by these structures. The diseases of the internal coat are the most interesting in a pathological point of view—those of the external coat in a practical one.

The coats of an artery are liable to the following changes:—1. Plastic Deposit on and under the Lining Membrane; 2. Fatty and Granular Degeneration; and 3. Calcification.

1. **PLASTIC DEPOSITS** on the free surface are of a fibrino-albuminous character, occurring in the form of rounded, semi-transparent, and gelatinous masses, usually met with in the aorta or larger arteries around the mouths of their secondary vessels, or of aneurismal sacs—not unfrequently appearing as agglomerated or calcareous spicula, and attaining great thickness. They are almost structureless, gelatinous, sometimes rosy-looking, and cut with a hard cartilaginous section. The plastic deposits on the attached surface of the lining membrane are opaque, semi-transparent, yellowish-white, elastic but hard masses, composed essentially of plastic matter with some oily globules intermixed.

2. **FATTY AND GRANULAR DEGENERATIONS.**—These are of the most interesting character, and play an important part in arterial diseases. They occur under the different forms of *Atheroma* and *Steatoma*, and are met with either in the arterial coats themselves, or in the plastic deposits which occur upon or underneath them.

Character.—The atheromatous deposits occur in very different forms, according to their age, &c. Their first appearance is in the shape of fine white opaque streaks, situated in the substance of the lining membrane of the artery. As such, they are most commonly met with in the upper part of the arch of the aorta and in the neighbourhood of the orifices of the large arterial trunks; especially along that part of the vessel from which the intercostals arise. Here they may be seen at a very early age. I have met with them in children of three, five, or seven years old. As the disease advances, these streaks aggregate together so as to form a large, white, and opaque patch. The middle coat now becomes thinned by the pressure of the patch, and, from being yellow and elastic, is altered into a grey, semi-transparent, and inelastic membrane, which often becomes stained by imbibition with blood, and corresponds to the steatomatous deposits of Scarpa and Halgren. In the third stage the patch softens, becoming converted into a pulsatious

or cheesy mass, and even sometimes undergoing complete liquefaction into a yellow creamy fluid, which has often been mistaken for true pus. These changes will always be found to be dependent on the abundant formation in it of fat-globules and scales of cholesterine. The softened atheromatous patch will be found to be situated in a kind of pouch or depression in the internal or middle coats of the artery, usually of a more or less oval shape.

At the same time when the changes just described are going on in the coats of the vessel, an important alteration is taking place in the connections between the internal and middle coats at the edge of the atheromatous patch. Here they become firmly incorporated together, so that the one cannot be peeled away from the other, and the diffusion of the softened atheroma between the two membranes is arrested. Thus also, when the atheroma is washed away by the current of the circulation, the infiltration of the blood between the coats and out of the pouch thus formed in the walls of the artery is prevented.

The changes just described as taking place in the internal and middle coats of the vessel are of a destructive character, and tend to its rupture; but, coincidently with these, conservative processes take place in the external coat. This becomes thickened, indurated, and strengthened by the deposit of plastic matter, until at last it becomes the sole support of the vessel, around the exterior of which it forms a thick and somewhat rugged wall. It is especially opposite the deeper and more eroded atheromatous patches that

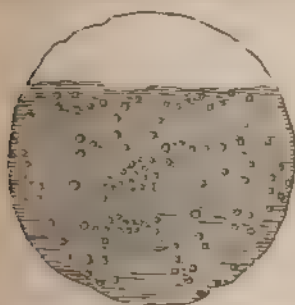


Fig. 185.—Fatty Deposit in Internal Coat.

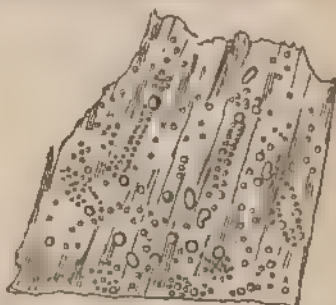


Fig. 186.—Early Stage of Atheroma.

this consolidation of the external coat takes place, thus preventing the perforation of the artery in this situation.

The Nature and Seat of these changes will be understood by what has been already stated concerning them. Atheroma essentially consists, as was first pointed out by Mr. Gulliver, in a fatty and granular disintegration of the arterial coats; the transformation into fatty and granular matter taking place both in old plastic deposits and in the internal and middle coats of the vessel. The fatty matter consists of oil-globules and cholesterine in various proportions (Figs. 185, 186), the plates of cholesterine being largest and most abundant in those cases in which the atheroma is the softest (Fig. 187). This fatty transformation is one to which the fibrous tissues generally are peculiarly subject, and to which those that enter into



Fig. 187.—Atheroma, with abundant cholesterine.

the formation of an artery are especially liable. All those theories are consequently erroneous which attribute atheroma to previous inflammation, suppuration, or to a deposit *ami generis* in the artery. The primary seat of these changes is the lining membrane of the vessel, in the outer layer of which, corresponding to Henle's *fenestrated coat*, they are first met with, as I have often observed after macerating and dissecting diseased arteries.

Effects.—The most important consequence of these changes in the structure of the artery is the effect produced upon its vital properties. Instead of being an elastic resilient tube, reacting on the contained blood and serving to regulate its distribution, it becomes inelastic, and consequently either gradually dilates in its calibre under the influence of the outward pressure of the blood contained within it, forming perhaps an aneurism; or, being incapable of regulating the distribution of the vital fluid, it tends to impair the supply to the organs to which it leads, and thus may indirectly occasion softening, disintegration, or mortification.

3. *CALCIFICATION* of arteries comes next in order of frequency to their fatty disintegration. This consists in the deposit in their coats of a quantity of hard and gritty earthy and saline matters, which, though commonly called osseous, present none of the true characters of bone—no trace of bone-corpuscle or of vascular canal being ever traceable in them. Microscopical examination shows them to consist of an irregular crystalline granular mass, without any evidence of organisation, composed, according to Lassaigne, of 50 parts of animal matter, $47\frac{1}{2}$ of the phosphate, and 2 of the carbonate of lime in every 100. The deposit always takes place in the first instance in minute sabulous grains or granules; these after a time coalesce, assuming different forms according to the seat of the deposit and the age of the individual.

Laminar Deposit.—This is the most frequent, and is principally met with in the larger arteries, such as the aorta, the iliac, and the carotids. In this variety, calcareous masses and plates of various sizes, from a grainlike sand to a shell-like plate an inch in width, are met with in these vessels. The thickness of the patch varies from that of silver paper to two or three lines. The shape is elliptic or triangular, the largest diameter being in the direction of the axis of the vessel. The edge of the plate is ragged, rough, and uneven, and the surface smooth and incurvated towards the cavity of the artery; if large, it is usually fissured or cracked, and surrounded by much atheroma. These patches are situated in the longitudinal fibrous coat, and are chiefly deposited where this structure abounds, as at the arch of the aorta, the bifurcation of the iliacs, and in the carotid arteries. The inner coat is usually thickened and opaque where it covers the patch, and the middle much thinned and wasted.



FIG. 188.—
Annular Calcification.

Annular Calcification principally occurs in arteries of the third magnitude, such as the popliteal and the femoral. It commences by the deposit of granules of calcareous matter (Fig. 188), which are arranged in lines running transversely to the axis of the vessel; these lines gradually increase in breadth until they coalesce laterally, the intervening spaces being filled up, and the vessel being converted into a rigid tube. This form of calcification occurs in the transverse fibres of the middle coat, and is accompanied by but little atheromatous matter.

Tubular Calcification appears to be an increased degree of the vari-
 ation

just described, the arteries being converted into pipes or tubes of calcareous matter, with the exception of a few shreds and patches, and some atheroma deposited in the coats (Fig. 189). It is especially the tibial and coronary arteries that are liable to this kind of transformation. When an artery has thus been converted into a tube of calcareous matter, masses of pale, opaque, waxy-looking fibrine are deposited in it, and may block it up more or less completely. These masses not uncommonly undergo subsequent atheromatous degeneration.

The various forms of fatty and calcareous transformation of the arterial coats that have just been described, are constantly found associated together in the vascular system of the same individual, and often indeed in the same vessel. It has been pointed out by Bizot that the symmetry of the arrangement of these morbid appearances in the corresponding vessels on opposite sides of the body is remarkably great, the arteries of one limb being often the exact counterpart in this respect to those of the other.

CAUSES.—The frequent co-existence of these various morbid changes in the same portion of the arterial system points to their origin from one common cause, under the influence of which the coats of the vessel may become converted into either fatty or calcareous matter. Indeed, it is quite evident that these are *retrograde metamorphoses*, to which all fibrous tissues are especially liable under the influence of want of proper nutritive activity in the part. And, indeed, any circumstance that induces a deprivation of healthy assimilation in the system generally, will speedily tend to occasion a transformation of the texture of the more lowly organised tissues into products still lower in the scale of organisation. Under such influences, the fibrous tissues of which the arterial walls are composed rapidly undergo disintegration, and conversion into fatty, granular, and earthy matter.

That influence under which the vital forces of the system are most commonly diminished in activity is *old age*; and this diminution may be looked upon as natural at any period after the organisation has reached its full maturity, whether this be early or late. So frequent, and indeed constant, are these transformations of the arterial coats during the decline of life, that they may be considered as the natural result of the diminution of the nutrient activity consequent upon advance in years. Gmelin has found that there is a progressive increase in the earthy matters contained in the coats of healthy arteries as the individual advances in life. Thus he has ascertained that the ash of the arteries of a newly born child yield 0·86 per cent. off phosphate of lime; the healthy arteries of an adult 1·25; and those of an old man 2·77 of the same salt; whilst the ossified arteries of an aged man contain 4·01. There is no precise period of life at which these changes set in: age is a relative term, and, so soon as the system has passed its full maturity, in whatever year of life this may happen, there is a tendency for these deposits to take place in considerable quantity. These senile transformations, therefore, can scarcely be looked upon as pathological changes in many instances. But the same process of degradation of tissue may commence at any, even the earliest periods of life, under the influence of causes that impair the vital forces; and it is in this way that phthisis, granular kidneys, chronic gout, constitutional syphilis, &c., have a direct tendency



Fig. 189. — Tubular Calcification.

to occasion these degenerations in the arterial coats. It is a favourite supposition with many pathologists, that these changes result directly from inflammatory action; this certainly does not appear to be the case, but it is by no means improbable that an artery in which the inflammatory process has taken place may thereby have its nutrition so modified as to become very susceptible to early and extensive degeneration, and that the plastic matter thrown out as the result of the inflammation will be especially liable to undergo those changes that ultimately result in their conversion into fat and calcareous matter.

Some arteries are more liable to these structural lesions than others, and the relative frequency of the various forms of deposit varies in different arteries. Thus the ascending aorta is most subject to fatty degeneration, whilst the calcareous transformation is most frequently met with in the arch and abdominal portion of the vessel. The arteries of the lower extremities (viz., the femoral, the popliteal, and the tibial) are chiefly affected with calcareous deposits, whilst the fatty are commonly met with in the vessels of the brain; and some arteries appear to be exempt from disease; thus, Tiedemann states that he has never found the cesophageal arteries diseased. The difference in the liability of different arteries to disease is, no doubt, a great measure to be accounted for by the different degrees of development of the longitudinal fibrous coat in different parts of the arterial system—the being, I believe, in most instances the primary seat of the affection. Thus, in the aorta, the coronary arteries, and those of the brain, in which it abounds, we find these transformations frequent. The distance of the trunk from the centre of circulation, and the consequent diminished nutritive activity of their coats in old people, may account for the frequency of their degenerations. Those points of the arteries, likewise, upon which the shock of the onward wave of blood is most directly received, are more subject to degeneration than neighbouring parts of the continuity of the wall of the vessel. This is especially observable at the origins of the arteries that spring from the arch of the aorta, and at the bifurcation of the iliacs. It is also not improbable that the increased pressure of the blood upon the coats of arteries that lead to diseased organs, through which the circulation is obstructed, may tend to their degeneration.

Sex exercises but little general influence on the liability to disease in the arterial system, though it specially tends to the occurrence of those changes in certain arteries. Thus Bizot states that the arteries of the upper extremity are most frequently diseased in women, and those of the lower in men.

LOCAL EFFECTS.—The structural lesions that have just been described produce certain local effects, often of considerable importance, on the parts which the affected vessels supply with blood. For the proper and healthy nutrition of a limb or part to be carried on, two great conditions are required, so far as its arteries are concerned:—1, that the integrity of the structure of the walls of the vessels continue perfect; and, 2, that their channels remain pervious. For, although the arterial system possesses remarkable conservative power in its arrangement and distribution that tend to counteract these effects, yet, by slow degrees, a deterioration of function and disintegration of structure take place in the part immediately supplied by the diseased vessel. Thus, in the limbs, we have all the signs of a defective circulation, coldness of the feet, cramps, and spasms of the muscles; whilst in organs, softening of tissue, fatty degeneration, and other evidences of the want of a proper supply of blood leading to impaired nutrition, manifest themselves. Besides these various changes, that take place in the parts to which the diseased arteries are distributed, ulterior effects are produced upon the vessels

themselves, which may lead to important consequences. These consist in Ulceration of the Coats of the Artery; their Spontaneous Rupture; Contraction or Occlusion of the Interior of the Vessel; and, lastly, its Dilatation into some of the various forms of Aneurism.

Ulceration of arteries, though frequently spoken of, in reality seldom occurs, the so-called ulceration being in general an erosion occasioned by a patch of softened atheroma and its investing membrane having been carried away by and into the current of blood, which then washes the base of the depression thus produced in the middle coat, but is prevented from extending between the coats by the process of fusion and cohesion which has taken place in them around the patch. This apparent ulcer is deepened by the deposit around its margin of plastic matter, often in large gelatinous-looking masses. When true ulceration of an artery takes place, it is by destructive action from without, and not by any of the disintegrating processes commencing within the vessel.

Spontaneous Rupture of an artery is rare, and never happens without disintegration of its coats. Experiments made by Dr. Peacock, which I have repeated, and the accuracy of which I can fully confirm, prove that a healthy artery can sustain a very great pressure from water injected into it, without its giving way. But if these have been softened or weakened by disease, they may be unable to resist even the ordinary impulse of the blood; and if this be driven on by any unusually forcible action of the heart, as under the influence of sudden violent strains or exertions, they may give way. This occurrence would be much more frequent than it is in atheromatous and calcareous patches, were it not for the conservative consolidation of the external coat of the vessel supplying that resistance which has been lost by the destruction of the internal and middle tunics. Hence this rupture is most frequent in those vessels the outer coat of which is thinnest, and in which, consequently, it can least supply the place of the others, as in the arteries of the brain and in the intrapericardial portion of the aorta.

Contraction and Occlusion of arteries are by no means rare sequences of the structural lesions of these vessels. We have already seen that these conditions may arise from inflammation of the coats in any way excited, as by the pressure of tumours; but, besides this, the structural changes that take place may produce narrowing and closure of the vessel in various ways. Thus the diseased patch may project into the artery in such a manner that plastic matter and coagulum are gradually deposited upon it, until the interior of the vessel is blocked up; or the irritation of the morbid products may give rise to chronic inflammation in the coats, occasioning contraction, the effusion of lymph, and their consequent occlusion. In one or other of these ways, arteries of all magnitudes may be gradually narrowed and at last completely closed; and yet the patient may survive, and the parts supplied by the obstructed vessel may maintain their vitality, in consequence of the collateral circulation being sufficiently active to keep up the supply of blood to them. The vessels that are most frequently blocked up in this way are the iliacs; next to these perhaps the carotids; the other arteries are but rarely so occluded. Yet many instances have been collected by Tiedemann of this morbid process affecting most vessels, but more especially the iliac, the brachial, and the axillary arteries, and the different branches of the abdominal aorta. Tiedemann records from various sources no fewer than eight cases in which the abdominal aorta was completely closed, in all of which so full and efficient a collateral circulation had been set up, that the vitality of the lower part of the body was perfectly maintained, and in most the morbid state was not suspected during life. Besides these cases, he states that there are twelve

instances on record of great narrowing of the aorta, at that point where the ductus arteriosus is implanted into it in foetal life. These would appear in some way connected with the closure of the duct; as in every case the indentation was greatest on the convex part of the aorta, which had been drawn in towards the mouth of the duct, as if the vital contractile force necessary for the closure of this had extended itself to the aorta, and produced a similar action in it.

When any of the arterial narrowings, or occlusions, occur in a gradual manner in early life, or in a part where the collateral circulation is free, no ill effects result; but in an opposite condition the interference with the circulation leads to the death of the part supplied by the diseased vessel. This is particularly the case in the lower limbs of old people, where the circulation is extremely feeble, both as the effect of age and in consequence of distance from the heart; and it is in this way that the true senile gangrene or mummification of the limb occurs. The symptoms and treatment of this affection have already been adverted to (pp. 431-433); but it may be here stated that, whilst some have considered the gangrene as entirely the result of arteritis, others look upon it as consequent on the occlusion of the vessel from disease of its coats; and each party has laid down principles of treatment in accordance with its view of the pathology of the affection. From what has preceded, it would appear that the arteries of a limb may be occluded, and that, consequently, gangrene may result from either condition. The occlusion from acute arteritis, followed by gangrene, most frequently occurs in the upper extremities, and in young or middle-aged people, and is preceded by local and constitutional symptoms of inflammation, and in it the artery presents on examination the true inflammatory plug. The occlusion from calcification and atheroma chiefly occurs in the lower extremities, and in old people; it is preceded by a rigid condition of the vessels—by cold feet, cramps, numbness, and weakness of the legs; and, after removal, the arteries will be found to be converted into rigid unyielding calcareous tubes, with some deposit of atheroma, and with waxy-looking masses of fibrine filling up their interior. Besides these two distinct forms of the disease, there is a third and very common variety, in which a low form of inflammation takes place in previously diseased arteries, and in which we find a combination of the two conditions.

With regard to the *Treatment* of narrowing or occlusion of the arteries, unconnected with gangrene, I have little or nothing to say; except that, if there be reason to suspect such occurrence in a limb, care must be taken to keep the part warm by means of appropriate clothing, and if there be much pain, to allay this with opiates. If gangrene have come on, it must be treated with reference to its cause. That connected with arteritis has already been discussed; but when it occurs from structural disease of the coats of the vessel, then the treatment must be directed by the existence or absence of any complicating inflammation, in accordance with those principles that have been laid down in discussing the general management of gangrene.

CHAPTER XLI.

ANEURISM.

By *Aneurism* is meant a tumour, dependent on the dilatation of the whole or a portion of the coats of an artery by the contained blood, and communicating with the interior of the vessel.

CAUSES.—The causes of aneurism are divisible into those that predispose to, and those that excite, the disease. Aneurism is *Predisposed* to by any affection of the arterial coats that lessens the elastic resiliency of the vessel, and at the same time weakens its resisting power. When the arterial walls have undergone more or less *fatty degeneration*, whether that consist in the distinct deposit of patches of atheroma, or in a sort of molecular deposit of fat globules in the tissues composing their coats, their natural elasticity and resiliency become lost, proportionately to the amount of fatty change that has taken place within them. Hence, as the artery becomes less and less able to contract on its contents, and to recover during the diastole the tension exercised on its walls during the systolic impulse, it gradually becomes distended by the repetition of the shocks which it sustains, and thus either complete or partial dilatation of its cavity takes place. I believe that this loss of elasticity and of power of contracting on its contents, which eventually results in the dilatation of the vessel, never occurs except as the result of previous disease of the coats. In the very numerous specimens of dilated arteries that I have examined, I have never found one that had not undergone fatty degeneration, or atheromatous deposition. Calcification, on the other hand, rather prevents than favours dilatation of the artery, by hardening the coats and converting them into rigid inelastic tubes; but atheroma softens them, and causes yielding of that portion of the vessel affected by it. I have frequently observed that the whole of the artery might be healthy except at one part, where there was an atheromatous patch, and where the vessel was dilated; or that the whole of its coats might be calcified except at one spot, where atheroma was deposited, and where consequently the coats had yielded under the outward pressure of the contained blood.

Age exercises a powerful predisposing influence on the occurrence of aneurism. This disease is excessively rare before puberty, yet it is occasionally met with at early periods of life: thus Syne mentions a case of popliteal aneurism in a boy of seven, and Hodgson has a preparation of a carotid aneurism in a girl of ten. It is during the middle period of life, about the ages of thirty and forty, that aneurisms are most frequently met with; at those ages, indeed, when the arteries have already commenced to lose their elasticity, in consequence of disintegrating changes, whilst, at the same time, the heart has not lost any of its impulsive force, or the general muscular system its contractile vigour; and when the enfeebled and inelastic vessels, becoming exposed to powerful causes of distension, may readily give way and be expanded at some one weakened point.

A *forcible, irregular, and occasionally greatly increased action of the heart* is the immediate cause of the overdistension and dilatation of the vessels, and thus of the production of aneurism. Hence we find that this disease is especially apt to be induced in those individuals in whom the muscular system is called upon to make sudden, violent, and intermittent exertions;

as, for instance, in men who habitually lead somewhat sedentary lives, but occasionally and suddenly change their habits, and indulge in sports, such as hunting, rowing, or a long day's shooting, which they might without risk have practised in early life, but which cannot be taken up with impunity at an age when the arteries, having become weakened, are unable to bear the same strain upon their coats as heretofore. I agree with Mr. Porter, in thinking that continuous, steady, laborious employments do not predispose to aneurism, as this disease is seldom met with amongst those of the lower classes who labour hard and uninterruptedly; but it rather occurs in those who, after long periods of comparative inaction, are occasionally and suddenly called upon to make very violent muscular efforts, disproportioned to their strength, or, at all events, to their previous habits. It is in this way that soldiers, sailors, and members of the higher classes in society, are rendered peculiarly liable to aneurism. As violent muscular exertion predisposes to this disease, we should necessarily expect to meet with it more frequently among men than in women, and, accordingly, Dr. Crisp finds that, of 551 cases of aneurism of all kinds, more than seven eighths occurred in men. It is important, however, to observe that different kinds of aneurism occur with varying degrees of frequency in the sexes: thus, this affection is met with in the carotid artery about as often in women as in men, whilst the other external aneurisms occur in the proportion of thirteen cases in males to every one that happens in a female. It is remarkable, however, that in the dissecting aneurism the proportions are reversed; for every one case in men, two occur in women.

Climate exercises an important influence on the occurrence of aneurism, which is far more frequent in cold than in hot countries. If we may judge of the prevalence of aneurism in a country by the number of published reports of cases, I should say that it is of more common occurrence in Great Britain and Ireland than elsewhere; indeed, Roux states that it is less frequent in France than in England. In America it is also of frequent existence; but in the East Indies it is comparatively rarely met with.

Cachexy induced by any cause, such as syphilis, chronic gout, or rheumatism, the abuse of mercury, &c., has a tendency to occasion disease of the coats of the arteries, and thus to predispose to aneurism. But, though mercury and syphilis are commonly said to tend specially to the production of this disease, I am not aware that we are in possession of any facts that would warrant us in coming to this conclusion; though there can be no doubt that the cachexy thus induced may dispose to it as much as any other cause. It is remarkable that phthisis is antagonistic to aneurism; though probably this may arise from the facts that the heart's action is feeble in that disease, and that violent muscular exertion is seldom undertaken by those labouring under it.

Any *obstacle to the free flow of blood* through an organ or the capillaries of a part, exercises an important influence in disposing to aneurism, as it throws an increase of pressure on the interior of the artery. Dr. Chevers believes that obstruction in the abdominal organs frequently occasions aneurisms of the abdominal arteries.

The only *Exciting or Direct Occasioning Causes* of aneurism are blows, violent strains, and wounds of an artery. When an atheromatous artery is concussed by a *blow*, the lining membrane covering the softened patch may be ruptured, the atheroma being poured out into the interior of the vessel; and thus the external coat, with perhaps a portion of the middle adherent to it, becoming exposed to the pressure of the contained blood before it has been fully consolidated by inflammation and plastic deposit, the foundation

of an aneurism may readily be laid. In very violent *muscular strains or efforts*, an artery may occasionally be completely torn across; and it is easy to understand how, under these circumstances, the increased pressure that is thrown upon its interior may give rise to dilatation of an already weakened portion of the vessel. *Wounds* implicating arteries are common causes of those various forms of aneurism that have already been discussed in considering injuries of arteries.

CLASSIFICATION.—Aneurism may be classified as follows:—

1. Fusiform.—True.

2. Sacculated.— { a. True.
 { b. False. { a. Circumscribed.
 { β. Diffused.

3. Dissecting.

1. FUSIFORM OR TUBULAR ANEURISM.—This is a preternatural dilatation of an artery, all the coats of which are equally expanded through the whole circumference of the vessel. It most frequently occurs in the aorta, but may, though rarely, be met with elsewhere. The fusiform aneurism is not a mere dilatation of the vessel, but there are elongation, thickening, and degeneration of its walls as well. The elongation of the artery in the fusiform aneurism is as marked as its dilatation, and is always very considerable. Thus the arch of the aorta may attain a length of several inches, with a considerable space between the origins of the carotids, the innominate, and the subclavian, at the same time that its walls are greatly thickened, nodulated, and rugged. Sometimes several tubular or fusiform aneurisms are met with in the same vessel, with healthy portions of the artery between them. From these dilatations sacculated aneurisms not uncommonly spring. On examining the structure of a fusiform aneurism, it will be found that it is always composed of an uniform expansion of all the coats of the artery, which are at the same time somewhat altered in character; thus, the outer coat is thickened, the middle rigid and inelastic, and the inner one stiffened, rugged, and tuberculated by the deposition beneath it of various plastic and atheromatous masses. No coagula, however, are found in the dilatation, but a few filamentary shreds of fibrine are occasionally seen to be attached to the inner wall. The arteries that are usually the seats of fusiform aneurism are the arch of the aorta, the iliacs, and the femorals; this particular form of aneurism never occurring in any vessels in which the yellow elastic coat is not largely developed, and hence not being met with in arteries smaller than the femoral.

The fusiform dilatation, especially when seated in the arch of the aorta, may attain a very considerable magnitude, and may consequently exercise very injurious pressure on contiguous parts, thus producing great distress and danger of life. It is usually extremely chronic, increasing very slowly, and being compatible with existence for many years; but at last it usually destroys the patient, and may occasion death in several ways. Thus, if it be situated in the aorta, the great mass of blood in the sac may, by impeding the circulation, overpower the heart's action, so that it may be unable to recover itself, and a fatal syncope may be induced. Then, again, death may result from pressure on important parts, as on the bronchi or œsophagus. In general, however, the cause of death is the giving way of a sacculated aneurism springing from the fusiform one. When, however, tubular aneurism of the arch of the aorta occupies the intrapericardial portion of the vessel, it not unfrequently happens that, owing to the absence of an external coat in this situation, the artery may rupture. It most commonly happens that a fusiform aneurism remains quiescent, being a source of dis-

comfort, but not of death, until the sacculated form of the disease spring from its side; and then thus, becoming the more formidable affection, may destroy life in some of the ways peculiar to it.

2. **SACCULATED ANEURISM.**—By the sacculated aneurism is meant a tumour springing from the side of an artery or of a tubular aneurism, with the interior of which it communicates by a narrow aperture, called the mouth of the sac. It is generally divided into the *True* and *False* varieties.

True Sacculated Aneurism.—By this is meant a partial dilatation of all the coats of the vessel. Its existence has been denied; thus Scarpa doubts the occurrence of such a disease, and Bizot seems disposed to coincide with him. With these eminent pathologists, however, I cannot agree; and though I am willing to admit that many of the so-called "true" aneurisms are not so in reality, yet I cannot doubt, from repeated observation, that Hodgson is right in saying that in their early stages aneurisms are not unfrequently of the true kind. Thus, we occasionally find, as Dr. Peacock has pointed out, small digital pouches springing from the walls of some of the larger arteries, through the whole of which the external, middle, and internal coats can be demonstrated by maceration to exist; and in those aneurisms which are formed by the dilatation of a comparatively large portion of the arterial wall, it not unfrequently happens that the tumour remains of the true kind for some time, as I have had occasion more than once to ascertain by careful dissection. But, after an aneurism has attained a certain size, its coats become so fused together, and so closely incorporated with the neighbouring tissues, that their precise structure cannot be made out. Indeed, for a sacculated aneurism to be of the *true* kind, I believe that two conditions are necessary:—1, that the tumour itself be small; and 2, that the mouth of the sac be of tolerably large dimensions. Porter says that he has never met with a *true* aneurism larger than a small orange; and, certainly, none of those that I have seen, provided they were of the sacculated kind, have exceeded this size. In true sacculated aneurisms, also, it is necessary that the mouth of the sac, or that portion of it which communicates with the interior of the artery, should be of a good size, and not bear too great a disproportion to the wall of the tumour. I cannot conceive a large sac with a small mouth to be a true aneurism; for, as the mouth of the sac corresponds exactly in size to that portion of the arterial coats which have been originally dilated, it is not easy to understand how a large sac can be expanded out of a small segment of the wall of the artery. Though, as in all cases of true aneurism, however small they may be, the size of the sac greatly exceeds that of its mouth, it is clear that there must have been not only expansion, but a degree of hypertrophy and overgrowth of the wall of the vessel, just as in the tubular aneurism.

False Sacculated Aneurism is that variety of the disease in which the internal, or the internal and middle, coats have been ruptured, and are consequently deficient. This is by far the most frequent form of sacculated aneurism, and is that which is met with of so great a size. In by far the majority of cases, the internal coat and the innermost layers of the middle coat have been destroyed by atheromatous degeneration, leaving an erosion or depression in the interior of the artery, with weakness of the corresponding portion of its wall, which becomes expanded by the outward pressure of the blood. In these cases the sac is principally formed by the expansion of the outer coat, to which some of the layers of the middle may still be adherent; but which is essentially strengthened and thickened by plastic deposits, and by adhesions to neighbouring parts, which have become fused into its composition. In these cases there are outgrowth, hypertrophy, and new deposit in and upon

the external coat, as is evidenced by its actually becoming thicker, instead of its being thinned, as it would be were it only expanded. The formation of an aneurism by the herniary protrusion of the internal and middle coats through an ulcerated aperture in the external coat has been described: but though there is a preparation in the Museum of the College of Surgeons that is supposed to illustrate this fact, I doubt the existence of such a form of the disease, and after careful examination think that the preparation in question looks rather like an artificial dissection than a true rupture of this dense and elastic coat.

A false aneurism may always be readily distinguished from a true one, by the greater magnitude that it attains, by the size of the sac being out of all proportion to that of its mouth, and, on a section of this being made, by the middle coat being seen to terminate abruptly in a thick and dense ring immediately around the mouth and neck of the sac. A false aneurism may either be so from the very first, the internal and middle coats having been destroyed by softening and erosion, and the external expanded and hypertrophied into a sac; or it may originally have been a true aneurism, some of the coats of which having given way, the conversion into the false variety of the disease has taken place.

Surgeons generally recognise two varieties of false aneurisms—the *circumscribed* and the *diffused*. By the *Circumscribed False Aneurism* is meant that form of the disease in which the blood is still contained within a sac, formed by at least one of the arterial coats, however expanded and altered in its structure this may be. The *Diffused* form of *False Aneurism* includes two distinct varieties of the disease. In one case there is rupture of the sac, and general and widely spread extravasation of blood into the cellular tissue of the limb or part. In the other case it happens that the sac formed by the dilatation and hypertrophy of the outer coat of the artery is ruptured, and the blood, although effused beyond this, is still confined in a sac of condensed cellular tissue, formed by the matting together with coagulum and lymph of the structures into which the blood has been effused.

3. *DISSECTING ANEURISM* is a remarkable form of the disease, originally described by Mr. Shekelton, in which the sac is situated in the wall of the artery between its coats. It originates in consequence of the internal coat of the vessel becoming eroded, and giving way before any of that adhesion and matting together of the tissues around the patch has taken place, which prevents the blood from being forced between the different tunics of the artery. The rupture, although originating in the internal coat, always extends between the layers of the middle one, splitting this up into two laminae, and in some cases it also separates the middle from the external tunic of the vessel. On examining the artery in a case of dissecting aneurism, its coats will always be found to be easily separable from one another, and to be very lacerable, often appearing soft and sodden as if macerated. For the production of this disease, indeed, two conditions are necessary: 1. That there be atheromatous disease of the artery, destroying a portion of the internal and of the innermost layers of the middle coat; and 2. That there be not only a want of plastic matter effused about the diseased part of the vessel, but also a general softening of the tissue of the middle coat, with want of cohesion between the different tunics of the artery: this, indeed, may be considered as the essential condition disposing to the formation of a dissecting aneurism, and causing the disease to assume this rather than the sacculated form.

The rupture constituting dissecting aneurism always takes place longitudinally along the middle coat, and may often extend to a very consider-

able distance. Thus it may reach from the arch of the aorta to the iliac or from the same part to the bifurcation of the carotids. The disease only occurs, however, in the aorta, and in its principal branches—in those arteries, indeed, in which the middle coat is highly developed, and the yellow elastic tissue abundant.

Classes.—Dissecting aneurisms arrange themselves into three distinct classes. 1. In one class, the blood, after having passed for a distance of several inches, or even more, through the substance of the middle coat, bursts through the external coat, and becomes effused into the cellular tissue outside the vessel, and around the seat of rupture, or into the neighbouring cavities. In these cases, which constitute the most common variety of the disease, death usually occurs rapidly, the patient feeling intense pain along the line of rupture, and falling into a state of syncope. 2. The external coat may become so thickened and strengthened by the deposit of plastic matter, that it resists the impulse of the blood, which consequently continues to pass between the layers of the middle coat until it meets a softened and atheromatous patch, and then again bursts into the canal of the artery. In this class of cases, the patient may live for years after the occurrence of the rupture, the new channel that the blood has taken becoming lined with a dense smooth membrane, and resembling closely the interior of the artery from which, however, it is separated by a kind of septum or mediastinum. The appearance here presented by the vessel has occasionally been erroneously described as constituting a double aorta. 3. The blood may take its way between the laminae of the middle coat, but does not escape farther by rupture of the external, or by the giving way of the lining membrane of the vessel. A sac is consequently formed in the substance of the middle coat, which may become chronic, but will at last undergo external rupture.

PROCESS OF FORMATION OF AN ANEURISM.—The progression of the changes leading to the formation of an aneurism is briefly as follows. The coats of the artery undergo fatty degeneration, and atheroma is deposited at one part; this softens, and the lining membrane covering it, perhaps with a portion of the inner layers of the middle coat, becomes eroded, or the walls of the vessel may be weakened at this point without any destruction of their coats. Cohesion, however, takes place between the tunics of the vessel at the eroded or weakened spot; and the outer coat becomes strengthened and thickened by the deposition of plastic matter. Distention next takes place at this point; if of the entire coats, a *true* aneurism is formed; if of the eroded tunics, a *false* aneurism occurs. But if no cohesion have previously taken place between the different coats of the vessel, the blood becomes effused into and between them, thus constituting a *dissecting aneurism*.

STRUCTURE OF AN ANEURISM.—An aneurismal sac, if it be composed of a dilatation of all the coats of an artery, may be recognised on dissection by the atheromatous and calcareous deposits which are met with in the tunics of which it is composed. If it be a false aneurism, it will be found that there is little, if any, of these deposits in the walls of the sac; that the middle coat usually terminates abruptly at its mouth, and that the external coat is greatly thickened and strengthened by the deposition of plastic matters. An aneurismal sac may vary in size, from a tumour not larger than a cherry to a growth of the magnitude of a cocoanut or large melon. The mouth, which is oval or round in shape, varies greatly in size, being always very small in proportion to that of the sac. Usually the interior of an aneurismal sac contains a quantity of decolorized fibrine, arranged in concentric laminae.

but moderate thickness; these laminae of fibrine are of a pale-buff colour, dry and somewhat brittle where they are most closely applied to the wall of the sac; the more external ones appear to be those that are first formed, and occasionally are found to have undergone a kind of atheromatous degeneration; as we approach the interior of the vessel, they become softer and more coloured, and at last, in the central portions, dark masses of coagulum are often met with. This decolorised fibrine appears to proceed from two sources. It is partly deposited from the blood which is heaped up in the interior of the sac, and thus deposits its fibrine much in the same way as when it is whipped in an ordinary vessel; this is probably the manner in which the principal masses are deposited. In some cases, however, it would appear as if it were formed by deposition from the wall of the aneurism; for the mass, not being out of the current of the circulation, cannot well have been deposited from the blood, but must in all probability have been the result of the effusion of plastic matter from the wall of the sac; under these circumstances there is little or any of that stratified arrangement that is observable in the fibrine which is deposited from the blood. The black coagulum that is occasionally met with in the middle of aneurisms differs in every way from the laminated fibrine just described, and is evidently the result of simple coagulation. The use of the deposited fibrine appears to be in a great measure to strengthen the walls of the sac, and thus to prevent the too rapid increase of the tumour. Another great purpose that it serves is to lessen the capacity of the sac, and thus to diminish the distending force of the blood which is injected at each stroke of the heart—the outward pressure depending as much on the area of the sac as on the force with which the blood is driven into it. Then, again, the lining of the walls of the sac with such a tough and elastic material as the stratified fibrine, must greatly tend to deaden and break the force of the shock of the wave of blood that is projected against what would otherwise be an unprotected and expanded membrane. In those cases in which the laminated fibrine is small in quantity or altogether deficient, the aneurismal tumour rapidly increases, with a forcible pulsation that is not met with under other circumstances.

PRESSURE-EFFECTS.—As the sac of an aneurism enlarges, it exercises injurious and often fatal effects by its pressure upon contiguous parts. These pressure-effects deserve attentive consideration and study, as they constitute an important and, in some instances, the sole element in the diagnosis of the existence of aneurism.

One of the most common pressure-effects of aneurism is the occurrence of cedema of the limb or part, owing to the compression exercised by the tumour upon the large and deep *venous trunks* in its vicinity. The consequent obstruction to the venous circulation in the interior of the limb may also give rise to a distended or varicose condition of the subcutaneous vessels, and in some instances it may even go on to the production of gangrene. The pressure of the sac, also, on neighbouring *arteries*, or even on the upper part of the very vessel from which it springs, and its interference with the general capillary circulation of a part, is commonly associated with the venous compression, and may considerably increase the ill consequences resulting from it. The pressure upon a neighbouring artery may go on to perforation of the vessel by the sac, and so a communication may be set up between the aneurismal sac and a neighbouring vessel; thus I have known an aneurism of the aorta to perforate and communicate with the pulmonary artery. By its pressure upon neighbouring *nerves*, an aneurismal sac may give rise either to great pain in the parts supplied by them,

or to disturbance of their function; the nerves themselves becoming, in some cases, expanded or flattened out, and ribbon-like (Fig. 190), and in



Fig. 190.—Flattening of Posterior Tibial Nerve by pressure of an Aneurism of the Calf



Fig. 191.—Erosion of Vertebrae by Aneurism.

other instances tortuous and waving, and being considerably elongated. The pain in the nerves is often one of the earliest signs of the existence of an aneurism. The pain is usually of two kinds: either lancinating and radiating along the course of the nerve that is compressed, or, when the tumour presses severely upon neighbouring parts and tissues, more especially if it give rise to erosion of the bones (as in Fig. 191), an aching, burning, tearing, or boring sensation is often experienced in the part subjected to the pressure. In other cases, again, important modifications in the function of parts take place, in consequence of the pressure that is exercised upon their nerves. Thus, for instance, the compression of the recurrent laryngeal will occasion hoarseness of voice and difficulty of breathing, depending on spasm of the glottis. On the *bones* an aneurism may produce very important effects by its pressure, eroding or wasting away the osseous tissue in some instances, and in others giving rise to true caries. If the bone be a flat one, as the sternum, the aneurism may perforate it by making as smooth and round a hole in it as if this had been worked by the trephine. *Organs and their ducts* in the neighbourhood of aneurisms suffer the most injurious effects from the pressure of these tumours, their functions being arrested, and the passage of their secretions interfered with; so also, by the pressure exercised on the *trachea* and *œsophagus*, respiration and deglutition may be seriously impeded.

NUMBER.—Aneurisms, though usually single, are not very unfrequently multiple. There may be more than one tumour of this kind in the same limb; thus the iliac and femoral arteries on the same side may both be affected. In other cases, corresponding arteries in opposite limbs are the seat of aneurism; thus, the two popliteals are not unfrequently found to be the seat of this disease, and occasionally an aneurism may exist in one of the limbs, and others in the arteries of the interior of the body. When more than one aneurismal tumour occurs in the same individual, the patient is said to be labouring under the *aneurismal diathesis*. Numerous aneurismal tumours are at times met with in the same person; thus, Pelletan records a case in which no fewer than sixty-five were observed.

DURATION.—The duration of an aneurism varies very greatly. In young full-blooded persons it often makes progress with great rapidity; whereas in elderly people of feeble constitutions, or in those of a cachectic habit of body, accompanied with more or less debility of the heart's action, the disease may assume a very chronic form; thus, Hodgson relates the case of an aneurism of the femoral artery of twenty years' duration. Much also will depend on the situation of the aneurism, the size of the mouth of the sac, and the relation of the sac to the impulse of the blood into it; the larger and more direct the mouth of the tumour, the more readily will the blood be projected into it at each impulse of the heart, and the more quickly will the tumour expand.

SYMPTOMS.—The symptoms of an aneurism are of two kinds: 1. Those that are peculiar to this disease; and 2. Those that are simply dependent on the presence of the tumour occasioned by the enlarged sac. The peculiar or pathognomonic signs are those that are dependent on the communication of the sac with the artery; they consist of signs afforded by the manual and auscultatory examination of the tumour; those that are dependent on the mere size of the growth are the pressure-effects. It is of course only in external aneurisms that those signs which are ascertainable on manual examination of the tumour can usually be recognised. In internal aneurisms, in the majority of cases, the auscultatory signs and the pressure-effects afford the best indications of the presence and nature of the tumour; though, when this approaches the surface, much information can be gained by palpation.

Symptoms of External Circumscribed Aneurism.—The tumour is usually round or oval, distinctly circumscribed, and is situated upon and in close connection with some large artery. It is at first somewhat compressible, but afterwards becomes more and more solid as fibrine is deposited in it. The most marked sign is, perhaps, the *pulsation* that is felt in it from the very first. This is of a distensible, eccentric, and expanding character, separating the hands when laid upon each side of the tumour, by a distinct impulse from within outwards. The pulsation is more forcible in aneurisms in which there is but little laminated fibrine; and as this increases in quantity it gradually loses its hard expanding character, being converted into a dead *thud*, and in some cases ceasing entirely. When pulsation is obscure, the compression of the artery below the sac will cause it to become more distinct, or it may be increased in force by elevating the limb or part affected. When the artery above the sac is compressed, the flow of blood into the tumour is necessarily arrested, and a considerable quantity of its more fluid contents may be squeezed out by gentle pressure. If the hands be then laid upon each side of the tumour, and the pressure suddenly taken off the artery, the blood will be found to rush into and distend the sac by a sudden stroke, separating the hands from one another. This may be looked upon as one of the most characteristic signs of aneurism.

The *bruit* or *sound* emitted by the blood in its passage through an aneurismal sac was first noticed by Ambrose Paré. It varies much in character, being usually loudly rasping or sawing—loudest and roughest in tubular aneurisms. In many cases it is altogether absent; this especially happens in sacculated aneurisms with small mouths, or in those that are much distended with coagula and blood. The absence of sound, therefore, in a tumour must not be taken as an indication of its not being an aneurism. The sound is usually best heard in tumours that are not too fully distended with blood; indeed, it is usually most distinct when the sac is partially emptied. Thus, for instance, it not unfrequently happens that in an aneu-

rism of the ham or thigh no bruit, or but a very faint one, is perceptible as long as the patient is standing up; but if he lie down, and elevate the limb so as to empty the sac, then it is very distinctly audible. Another of considerable importance consists in the *diminution in the size* of the tumour, and the *cessation of the pulsation and bruit* in it that occurs on compression of the vessel leading to the sac, and the immediate and sudden return of these signs on removing the pressure from the artery. All the symptoms we have just been described are peculiar to and characteristic of aneurism being dependent on the communication that exists between the artery and the sac. Those that result from the pressure of the sac upon neighbouring parts are common to aneurism and to any other kind of tumour; but, though not of so special a character as those that have just been described, they are of considerable importance in determining the nature of the disease when taken in conjunction with the other symptoms.

Symptoms of Diffused Aneurism.—When a sacculated circumscribed aneurism becomes diffused, the sac having given way, but the blood being still bounded by the tissues of the limb, the patient experiences a shock, and acute pain in the part, and usually becomes pale, cold, and faint. On examination, it will be found that the tumour has suddenly and greatly increased in size, at the same time that it has lost its circumscribed and distinct outline. The pulsation and bruit become materially diminished in force and in distinctness, having receded as it were from the surface, and may disappear altogether. The limb may also become oedematous, or may suffer in other ways from the diffused effects of the pressure of the aneurismal swelling upon the neighbouring veins and tissues. At the same time, the circulation in it being greatly obstructed, the limb may become cold and livid, and a sensation of weight and general inutilty will be experienced in it. Under these circumstances the aneurismal swelling usually becomes *hard*, in consequence of the coagulation of the blood in the cellular tissue around the sac; by which indeed the further extension of the disease is arrested, and a fresh boundary is often formed, so as to limit the extravasated blood. If it be left to itself, the tumour will now usually rapidly increase in size, sometimes without, sometimes with much pulsation, and perhaps evidence of inflammatory action around it, so that at last it may so obstruct the circulation through the limb as to occasion gangrene; or, if it advance towards the surface, the skin covering it becomes thinned and reddened, the tumour becomes soft and semi-fluctuating, owing to the coagulum breaking down, and eventually external rupture of the sac will ensue.

In other cases it happens that, when rupture of the sac takes place, the effused blood, instead of being limited by the surrounding cellular tissue, becomes suddenly and widely extravasated into the substance of the limb. When this untoward accident happens, the shock and local disturbance are very great, and the patient is suddenly seized with a very severe lancinating and numbing pain in the part. This pain is most severe in those cases in which the rupture takes place under the deep fascia, by which the effused blood is tightly bound down; and it may be so severe as to occasion syncope. In other instances, faintness occurs from the sudden loss of blood out of the current of the circulation into the substance of the part, the swelling being greatest in those instances in which the blood is suddenly and largely effused into the cellular tissue. If the extravasation happen in a limb, this will become greatly swollen, hard, brawny, and cold. The superficial veins are congested, and the circulation in the lower parts of the member is soon completely arrested by the pressure of the extravasated and semi-coagulated blood upon its vessels, more particularly the large venous trunks. In some

sequence of this, gangrene of a moist kind usually makes its appearance, and speedily destroys the patient's life.

DIAGNOSIS.—The diagnosis of aneurism may in many cases be effected with the greatest possible ease by a student in surgery; in other instances it requires a vast amount of care, and the most experienced judgment, to come to a correct conclusion as to the nature of the tumour. This is easily done when the aneurism is superficial, recent, and circumscribed, the blood in it being fluid, and all the signs of the disease well marked. The diagnosis is often replete with difficulty when the aneurism is deeply seated, or, if external, when it is old and filled with coagula; also if suppurative action have taken place about it, or if it have become diffused.

In effecting the diagnosis of aneurism we have, in the first place, to ascertain the existence or absence of a tumour; and, after this has been done, to ascertain whether it be aneurismal or of some other character. Both points, the latter especially, are difficult to determine in internal aneurisms; in the external, the doubt is not as to the presence of a tumour, but as to its nature. The tumours with which aneurisms may be confounded may conveniently be divided into two classes—those that do and those that do not pulsate.

Every pulsating tumour is not an aneurism. Thus there may be pulsation in various kinds of *encephaloid tumour*, or in *growths composed of erectile tissue*. In such cases as these, many of the signs of aneurism are present; thus the size of the tumour may be diminished by compression, and the distinct influx of blood into it may be felt on the removal of the pressure, the tumour returning to its original size with a soft swelling pulsation. There may also be a bruit, often of a loud and distinct character. But these tumours may generally be distinguished from aneurisms in not being quite so distinctly circumscribed—in being soft, spongy, and elastic, without the sensation of fluid that is met with in some forms of aneurism, or of solid coagula that occurs in others. Again, the bruit is either of a soft, blowing, and more prolonged character, or else sharp and superficial; the pulsation, also, is not so distinct, and is more of the nature of a general swelling and heaving of the tumour than of a distinct thump. Much light is also occasionally thrown upon these affections by their being met with in situations where aneurism cannot occur from the absence of any arteries of sufficient size to give rise to it, as, for instance, on the head of the tibia or the side of the pelvis; but if a tumour of this kind be situated upon or under a large artery in the usual site of an aneurism, then the diagnosis is certainly replete with difficulty, and cannot indeed in many cases be made. Several instances have of late years occurred, in which surgeons of the greatest skill and experience (as Guthrie and Stanley) have ligatured arteries, on the supposition that they had to do with aneurism, when in reality it was one of the pulsating tumours just described that closely simulated it.

Pulsation may be communicated to a tumour of a fluid character seated upon an artery; here the diagnosis, though often difficult, is more readily made than in the last case. Attention to the history of the case, to the impossibility of diminishing the tumour by pressure, either directly upon it or on the artery leading to it, its fluctuation, and want of circumscription, will usually point out its nature. Especial attention should likewise be paid to the facts that the pulsation is a distinct heaving up and down of the tumour, and neither excentric nor distensible, and that the swelling may often be wholly or partly separated, by raising it up, from the artery lying beneath it. By attention to these points, abscesses in the axilla, under the pectorals, at the root of the neck, and in other situations where pulsation

may readily be communicated to the fluid mass, can be distinguished from aneurism; yet errors in diagnosis have happened, and will continue to do so, from the intrinsic difficulty of these cases, and from no want of skill or care on the part of the surgeon: and those will be most charitable to the critics on the mistakes of others, who have most frequently had occasion to experience these difficulties in their own practice.

Tumours that do not pulsate, either by their own vessels or by those that lie beneath them, are not so readily confounded with aneurism as the class of affections that has just been described. Yet it must be borne in mind, that in some instances even aneurisms do not pulsate, or but very indistinctly so, having become filled with a dense and firm coagulum. The non-pulsating tumours that chiefly require attention are *glandular*, *arterial*, or *ganglionic swellings*, seated over the carotid artery, at the root of the neck, or in the popliteal space. If these be of a fluid character, the fluctuation, unvarying size, and the want of pulsation in them, sufficiently indicate that they are not connected with the artery, from which they may also frequently be separated, and upon which they may be distinctly marked. If solid, they are usually irregular and nodulated on the surface, and can frequently be detached by the fingers being passed underneath them and raising them from the subjacent vessel. I believe there is more danger of mistaking a consolidated aneurism which is undergoing or has undergone spontaneous cure, and in which there is consequently no pulsation, for a solid (perhaps a malignant) tumour of some kind, than the reverse. I have known one instance in which the thigh was amputated for a very painful solid tumour of the popliteal space, which proved on dissection to be a consolidated aneurism pressing upon the posterior tibial nerve (Fig. 19th).

Aneurisms, more particularly those that are diffused, have not infrequently been mistaken for *abscesses*; and it is no very uncommon thing for a surgeon to be called to an aneurism which, under this supposition, has been diligently poulticed, or painted with iodine ointment. Occasionally, the more fatal error has been committed of puncturing the tumour with the view of letting out pus, when none appears, and, either immediately or after a lapse of a few hours, proper arterial hemorrhage ensues. That this accident may arise from the intrinsic difficulties of the diagnosis, is evident from the fact that it has happened to such surgeons as Desault, Pelletan, Dupuytren, Pirogoff, and others of less note. I have once actually seen this accident occur to a surgeon of considerable experience, who, mistaking a diffused popliteal aneurism for an abscess, opened it with a bistoury, but finding no pus, applied a poultice; alarming hemorrhage ensued in about forty hours, and I amputated the thigh on the second day after this untoward occurrence.

The difficulty in diagnosis is especially apt to occur in those aneurisms which, having become diffused, have ceased to pulsate, have no bruit, are elastic, softened, and diffident to the feel, and in which the skin has become reddened and inflamed by pressure from within. It is only by careful attention to the history of the case, and by skilful manipulation, that the true nature of the tumour can be made out. But an aneurism may actually become associated with an abscess in one of two ways. Thus it may suppurate, inflammation of a suppurative character taking place in the cellular tissue around it, with swelling, redness, œdema, and heat of the integumental structures, increase of size in the tumour, and probably diffuse solidification of it. If this abscess be opened or allowed to burst, dark grumous pus will escape, followed by coagula and masses of broken down decolorised fibrine, and sometimes accompanied, but more usually followed after a lapse of some hours, by a free and perhaps fatal discharge of florid blood.

Another form of combination between abscess and aneurism consists in the opening of an artery by ulceration into the cavity of an abscess, so that the blood is projected directly into this from the opened vessel. In cases of this kind—of which the instance that occurred to Mr. Liston is a good example—we have the ordinary signs of abscess, usually of a chronic character, to which those of an aneurism are generally suddenly superadded, with great increase in the bulk of the tumour. This accident has chiefly been observed in abscess of the neck, opening up a communication with the carotid artery.

With *rheumatism* and *neuralgia* it would at first appear to be difficult to confound an aneurism, but in practice it is not so. I have known several cases in which the lancinating pains of aneurism, more especially when the tumour was internal, have been mistaken and treated for rheumatic or neuralgic affections; and I have even known the pain occasioned by the presence of a large aneurism of the thigh treated for several weeks as rheumatism. In such cases as these, it is of course obvious that a little care and proper examination will usually serve to establish the diagnosis. The aneurismal may be distinguished from the rheumatic pain by its having a twofold character—being both lancinating and intermittent, as well as continuous, aching, and burning. When this kind of pain is persistent, especially about the back, the side of the head and neck, or arm, it ought always to cause the surgeon's attention to be directed to the condition of the neighbouring large vessels.

TERMINATIONS.—*Spontaneous Cure* of an aneurism is of very rare occurrence. The manner in which it happens has been especially and ably studied by Mr. Hodgson, and more recently by Dr. Bellingham; and the pathology of this process is of considerable interest, from its bearing upon the cure of the disease by surgical operation. The spontaneous cure may accidentally, though very rarely, occur by inflammation of the aneurism and consequent obliteration of the artery; but most frequently it is by the gradual deposition of laminated fibrine in the interior of the sac that it is filled up completely. This process can only take place in arteries of the second or third magnitude, and never in aneurisms of the aorta; and it can only happen in the sacculated aneurisms, the fusiform not admitting of it, it being necessary that the blood flowing through the sac be somewhat retarded in its passage, so as to give time for the deposit of its fibrine upon the interior of the tumour. This process, which is a very different one from the coagulation of the blood, is the increase of a natural condition always going on in the sac. In all cases of sacculated aneurism, there is a tendency to the production of a spontaneous cure, though this is so rarely accomplished. The tendency to it takes place by a contraction and partial occlusion of the artery below the sac, and the consequent diminished force of the circulation through it, by which the deposition of fibrine is greatly increased, at the same time that the collateral vessels given off above the sac often enlarge to a considerable extent, and thus divert from it blood which would otherwise have passed through it. This condition of the vessel below the sac may be looked upon as the first and most important step towards the consolidation of the tumour. The process is also materially assisted by the mouth of the sac being small, and so situated that the blood cannot be directly driven into it.

For spontaneous cure to take place, however, it is necessary that the current of blood should continue to circulate through the sac. If it be suddenly arrested, coagulation of the blood which happens to be in the sac may there take place, filling it with a large dark soft clot; the sudden formation of which is indeed, like a foreign body, apt to induce suppuration

and sloughing of the sac and neighbouring tissues, and hence is rather pathological than otherwise. But, though the blood continue to circulate through the sac, the deposit of fibrine will not take place unless the impetus with which that fluid is sent into and through the tumour be considerably diminished. This may happen from the occurrence, in the distal portion of the artery or the mouth of the sac, of some or other of those conditions that have already been described. So, also, it has been found that, in these cases in which two aneurisms are situated upon one artery, the second or distal one is very apt to undergo partial or even complete consolidation, the blood losing its impetus in its passage through the first sac. Any constitutional cause or condition also, by which the impulse of the heart is lessened, and the force of the flow of blood through the sac diminished (as the occurrence of phthisis), will favour greatly the deposit of laminated fibrine, and the consolidation of the tumour.

As the aneurism undergoes spontaneous cure, the pulsation in it gradually becomes more and more feeble, until it ceases entirely; the bruit proportionately lessens, the tumour becomes harder, and at last completely consolidated; at the same time, the anastomosing circulation is sometimes found to be established in some of the collateral vessels of the limb. Eventually, the solidified tumour shrinks in size, undergoing a species of drying and absorption, with ultimate conversion into a small mass of fibro-cellular tissue.

Causes of Death from Aneurism.—An aneurism may prove fatal in various ways. It does so when internal, most frequently by pressure on parts of importance in its vicinity, the patient being destroyed by the exhaustion induced by interference with their functions; this is usually the way in which aneurisms of the aorta occasion death. Then, again, death may result by the occurrence of *syncope*, more especially if the aneurism be of large size, and situated near the root of the aorta. External aneurisms most commonly prove fatal by *rupture of the sac*; this may either take place into the interior of a limb, giving rise to one or other of the diffused forms of aneurism, and terminate fatally by the induction of syncope or gangrene; or they may kill by rupture occurring externally, on one of the surfaces of the body.

Suppuration with sloughing of an aneurismal sac is not of very frequent occurrence, but is especially apt to happen in those cases in which the disease has increased rapidly, or suddenly become diffused, with much heat and tension of neighbouring parts. It is peculiarly likely to happen in tumours of a large size that have become partly diffused, that are filled with masses of decolorised fibrine, and that are situated in places where the cellular tissue is loose and lax, as in the axilla. The symptoms of this condition impending are swelling, tension with heat, throbbing, and redness of the parts around the tumour; the integuments covering which put on pressure, and are evidently deeply inflamed, at the same time that there is a good deal of fever and general constitutional irritation. As the suppuration advances, the ordinary signs of congestive abscess occur: the skin covering the tumour becomes red and livid at one part, where pointing takes place; and if the surgeon make an incision into it, or if the tumour burst (as assuredly it will if left to itself), a quantity of sanious pus mixed with large masses of broken down coagula and fibrine will be let out. The discharge of the contents of the aneurismal sac, disintegrated by and mixed up with the results of suppurative action, may be followed by so profuse a gush of arterial blood that the patient is suddenly exhausted.

The rupture of an aneurism is not always immediately fatal, the aperture

in the sac being plugged up by a mass of coagulum, as happened in case Fig. 192; on the gradual detachment of the deeper portions of which the



Fig. 192 - Aperture in Oesophagus produced by Pressure of an Aortic Aneurism.



Fig. 193 - Stellate Rupture of an Aortic Aneurism into Pericardium

bleeding may recur in small quantities at intervals, and more or less speedily carry off the patient. On the mucous surfaces, as of the oesophagus or trachea, rupture occurs in a similar manner (Fig. 192). On the serous surfaces, as into the pleura or pericardium, the aneurism may burst by a fissure or stellate opening (Fig. 193) forming in the membrane. An aneurism has been known to give way and discharge blood for some weeks before it proved fatal; and it may even happen that, after the rupture has occurred, no hemorrhage may take place, but death may result from the pressure of the tumour. Thus, in the case of the late Mr. Liston, the sac of the aneurism which caused the death of that great surgeon had actually given way, a mass of coagulum projecting from it into the trachea; yet death resulted from the irritation induced by pressure upon the inferior laryngeal nerve, and not from hemorrhage.

TREATMENT.—The treatment of aneurism is of two kinds—constitutional and local. In many cases, as in the various forms of internal aneurism, for instance, the constitutional treatment can alone be employed; and in all cases of external aneurism it should be had recourse to as an important adjunct to any local measures that are adopted.

In the *Constitutional or Medical Treatment* of aneurism, the great object is to bring about the same condition as that by which the spontaneous cure of the disease is affected, and, indeed, to put the patient and the part in the most favourable state for nature to consolidate the tumour; and, though it may not be possible in the great majority of cases to effect a cure in this way, at all events the disease may be palliated, and its progress retarded. The sacculated is, however, the only form of aneurism that can ever be cured by constitutional means; in the fusiform variety, all that can be done is to retard the progress of the disease.

The principal objects to be held in view are, in the first place, to lessen the force of the heart's impulse, so as to diminish the excentric pressure upon the arterial coats; and, secondly, so to modify the condition of the blood as to dispose it to the deposition of its fibrine. In carrying out these indications, it should be borne in mind that there are two opposite conditions of the system in which aneurism occurs; in one there is a plethoric, and in

the other an anemic tendency. The plethoric and irritable state of system chiefly occurs in young subjects, in whom the progress of the disease is acute and rapid, attended by much impulse and excitability of the heart, and throbbing of the arteries generally. The other condition of the system principally occurs in elderly people, in whom there is a feeble pulse, a weak heart, a cachectic state of health, and a tendency to anæmia; in such a habit of body the disease makes slow progress. In these opposite conditions it is perfectly clear that the same plan of treatment cannot succeed; and that the constitutional means must accordingly be modified according to the state in which the patient is.

In the acute or hypereemic state, the plan of treatment originally introduced by Valsalva, and hence called by his name, by which plethora is removed, the irritability of the heart and the force of its action lessened, and the blood brought into a healthy condition, may be advantageously employed, in the modified manner that has been recommended and adopted by some modern surgeons. Pelletan and Hodgson especially report very favourable results of this treatment, and I have seen several instances in which it has proved decidedly beneficial. As recommended by Valsalva, this method of treatment was intended to carry out two important points: 1, by a process of gradual starvation and depletion to reduce the quantity of blood in the system, the power of the heart's action, and consequently the pressure exercised upon the walls of the aneurism; and, 2, after the patient had in this way been reduced, the plasticity of the blood was to be improved by feeding him up in a gradual and careful manner, so that the tendency to the deposit of laminated fibrine might be increased. Valsalva endeavoured to carry out the first of these objects by subjecting the patient to small and repeated bleedings, and by gradually reducing the quantity of food that was daily taken, until it was lowered to half a pound of pudding in the morning, and a quarter of a pound in the evening. In this way the patient's strength was reduced until he could scarcely be raised up in bed without fainting; the quantity of food was then gradually augmented, so that the plasticity of the blood might be restored. It is seldom that surgeons carry out Valsalva's plan of treatment in the precise manner indicated by him; it is most commonly found to be more convenient to modify it somewhat according to the circumstances of the case, though the principles on which it is conducted are essentially the same.

In adopting any constitutional treatment in cases of aneurism, the first and most essential point to be attended to is, to keep the patient perfectly quiet in bed and free from all mental, emotional, or conversational excitement. The diet should at the same time be very carefully regulated, being gradually reduced in quantity, and being made to consist principally of farinaceous food, with but a very small quantity of meat, but little liquor, and a total absence of all stimulants. Perhaps the best regimen is that recommended by Bellingham, consisting of two ounces of bread and butter for breakfast, two ounces of bread and the same quantity of meat for dinner, and two ounces of bread for supper, with a little milk and water, occasionally sipped in small quantities. At the same time purgatives should be administered, especially such as give rise to watery stools, and remove obstructions of the portal and renal systems; with this view a scruple of the compound jalap powder may be given twice a week. In some cases, if the heart's action be particularly strong, recourse may advantageously be had to small bleedings from time to time.

By judiciously carrying out this plan of treatment and modifying it according to the circumstances of the case, consolidation of the aneurismal

tumour may occasionally be produced; or, if this be not attained, the progress of the disease will be very materially retarded.

When aneurism, however, occurs in feeble, cachectic, and anemic patients, this plan of treatment is altogether inadmissible: here, the blood being deficient in fibrine, and the system in an irritable state from debility, the best results follow such a course of treatment as will improve the plasticity of the blood, and regulate the action of the heart. With this view, complete rest, the administration of the preparations of iron, a dry but nourishing meat diet, and the occasional employment of opiates to relieve pain and to quiet the system, will be attended by the best results. In aneurism occurring in elderly people, and amongst the poorer classes, this plan of treatment is perhaps more successful than any other.

In the *Local Treatment* of aneurism but little can be done with the view of checking its progress, except by the employment of direct surgical means. The application of ice to the surface of the tumour is said to have acted beneficially in some cases; but it is a painful remedy, and may occasionally be attended by sloughing of the skin to which it is applied. When the pain attending the increase of the tumour is considerable, much relief may be obtained from the application of belladonna plasters, or the use of an embrocation composed of equal parts of oil and of the strong tincture of aconite. These means comprise the only local measures that can be adopted in those cases of internal aneurism, which are beyond the reach of surgical interference.

SURGICAL TREATMENT OF ANEURISM.

In all those cases in which it is possible to delay with safety, no surgical proceeding should be undertaken for the cure of aneurism until the patient has been subjected to proper constitutional treatment for some time; the success of the more direct surgical means depending greatly, in the hyperemic forms of aneurism, on the heart's impulse being lessened, and in the blood being got into as healthy a state as possible; whilst, in the anemic form of the disease, an increase in the plasticity of the blood is essential for the cure of the case; for, as the occlusion and consolidation of the sac, after surgical procedure, depend on the same conditions being induced that are successful after medical treatment, the same constitutional means should be adopted in one case as in the other. Before proceeding to the employment of any direct surgical means for the cure of an external aneurism, it is necessary to ascertain that there is no internal aneurism present, and that the heart is free from disease. From want of this precaution, it has happened that patients have died on the operating table at the moment when the artery was being ligatured, or that they have expired shortly afterwards, from the disturbance of circulation consequent upon the necessary surgical procedures.

Surgeons are in possession of several modes of treating external aneurisms: viz., Ligature, Compression by Instruments, Flexion, Digital Compression, Manipulation, Galvano-puncture, and Injection.

LIGATURE.—The employment of the ligature was the only means adopted by surgeons, for the cure of aneurism, up to a very recent date; the use of compression in the treatment of the disease, as at present employed, being one of the most modern, as well as one of the greatest improvements, in surgical practice. The manner in which the ligature should be applied, and the various cautions respecting its use, have been sufficiently discussed (page 168 *et seq.*). The question as to the part of the vessel to which it should be applied in aneurism, remains for consideration; and this involves some important points.

Situation.—There are three situations in which the ligature may be applied: 1, above and below the sac, by the old operation; 2, on the cardiac side of the sac, by Anel's (Fig. 194) or Hunter's (Fig. 195) operation; 3, on the distal side of the sac, by Brasdor's or Wardrop's operation (Fig. 196).

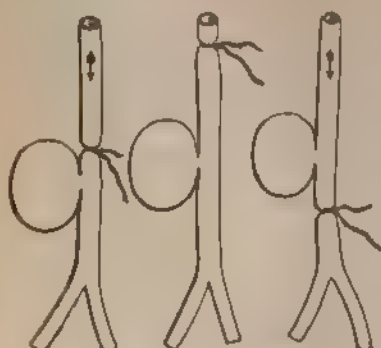


Fig. 194 —Anel's Operation. Fig. 195 —Hunter's Operation. Fig. 196 —Distal Operation.

1. The application of the ligature on both sides of the aneurisma is seldom practised at the present day, when the aneurism arises from disease of the coats of the vessel, but in those cases in which it comes from traumatic causes, it may frequently be adopted as the best means of cure, even in aneurisms of the largest size, as has been mentioned in the chapter on Traumatic Aneurism. The older surgeons, however, were acquainted with this mode only of treating aneurisms. The mode of applying the ligature to both sides of the sac is as follows. After having arrested the circulation through the aneurism, by compressing the artery leading to it, either by means of a tourniquet, or, where that is not applicable, by the pressure of an assistant's fingers, the surgeon slits up the sac, turns out the contained coagula and masses of fibrine, and then, passing a probe upwards and downwards into the artery, through the mouth of the sac, ties the vessel on each side, immediately above and below the aperture. This operation, as performed by the older surgeons on any of the larger arteries, as the popliteal, was not only so difficult in itself that surgeons were seldom willing to undertake it, but was so fatal in its results, being commonly attended by secondary hemorrhage in consequence of the artery being ligatured in a diseased part, or by diffuse inflammation, suppuration, and gangrene in the deeper tissues of the limb operated upon, that recovery after its performance was considered a miracle, and most surgeons preferred submitting the patient to amputation at once, to the risks of so hazardous a procedure.

2. The ligature of the artery on the cardiac side of the aneurism, without opening the sac, was first done by Anel, in the year 1710, in a case of brachial aneurism. This operation, though attended with the risk of wounding or inflaming the sac, which was in close proximity to the seat of ligature, constituted a considerable advance in the treatment of the disease, inasmuch as it did not necessarily lead to the opening up of the aneurismal tumour, and to the dangers that were inseparable from that mode of procedure. As Anel, however, performed his operation as a mere matter of convenience in a particular case, and without the recognition of any new principle of treatment being involved in it, it attracted but little attention at the time, and does not appear to have been repeated by any of the surgeons of his day.

It was reserved for John Hunter to make the great improvement in operative surgery of ligaturing the artery at a distance from the sac, where its coats were healthy, and where there was no danger of interference with the aneurism itself. In this way the objections to Anel's operation were avoided, for though, like Anel, Hunter tied the artery on the cardiac side only of the sac, yet he differed from him in doing so in a healthy part of its course, and at a considerable distance above the tumour, where the application of the

ligature would be attended with less risk of hemorrhage, and with no danger of opening, irritating, or inflaming the sac, which are inseparable from Anol's operation. The following are the reasons, given in Sir Everard Home's own words, that induced John Hunter to adopt the operation that is now generally known in surgery as the *Hunterian*. "Mr. Hunter proposed, in performing this operation, that the artery should be taken up at some distance from the diseased part, so as to diminish the risk of hemorrhage, and admit of the artery being more readily secured should any such accident happen. The force of the circulation being thus taken off from the aneurismal sac, the cause of the disease would, in Mr. Hunter's opinion, be removed; and he thought it highly probable that, if the parts were left to themselves, the sac, with the conglobated blood contained in it, might be absorbed, and the whole of the tumour removed by the actions of the animal economy, which would consequently render any opening into the sac unnecessary."

Hunter's first operation was performed in December, 1785, in a case of popliteal aneurism, in which the femoral artery was ligatured rather below the middle of the thigh, underneath the sartorius muscle; and since that time it has been universally employed by surgeons as almost the only mode of treating aneurism, until the introduction of compression in 1842.

The *Effects produced upon the aneurismal tumour by the ligature of the vessel according to the Hunterian method*, deserve careful attention. The immediate effects, on drawing tight the ligature, consists in a cessation of pulsation and bruit in the tumour, which at the same time subsides, becoming partially emptied of its blood. The supply of blood to the limb being in a great measure cut off, it becomes numb and cold, with a diminution of muscular power. The more remote effects consist in an increase of the activity of the collateral circulation, by which the vitality of the limb is maintained. At the same time, and, indeed, in consequence of this, the temperature of the limb often rises, until it becomes higher than that of its fellow.

The consolidation of the aneurismal tumour begins as soon as the ligature is applied, and is usually completed in a few days, by changes taking place within it similar to those that occur in the spontaneous cure of the disease. This important change is effected by the gradual deposit of stratified and decolorised fibrine in concentric layers within the sac, and not by the sudden coagulation of its contents. For this deposition to take place, it is necessary that, though the direct flow of blood through the tumour be arrested by the ligature of the main trunk, some should yet be carried in by collateral channels. This is a necessary condition for the success of the ligature; for, if it happen that all the flow of blood through the tumour be arrested, coagulation of that which happens to be contained in it will ensue, followed by gangrene, supuration of the sac, and other unfavourable results; the coagulum appearing to act as a foreign body, and to be insusceptible of those changes that are necessary for the consolidation of the tumour. It is of importance to observe, that the proper consolidation of the aneurismal tumour, by the deposit of laminated fibrine, will occur even though a very considerable quantity of blood continue to flow through it. In the Museum of University College there is an exceedingly interesting preparation that illustrates this point; it is one in which Sir Charles Bell ligatured the femoral artery for popliteal aneurism. The patient died a week after the operation, from erysipelas; on examination, it was found, and is shown by the preparation, that the femoral artery was double, and that, though only one portion of the vessel had been ligatured, the tumour, which continued to be supplied by the other, was completely consolidated. Hence, it would appear that, if one half of the

influx of blood only be arrested, obliteration of the sac by deposition of laminated fibrine may be expected to occur. After the aneurismal sac has been thus occluded, it progressively diminishes in size, and is at last converted into a small fibro-cellular mass. The artery that has been ligatured becomes closed at two points—at the part deligated (Fig. 197, a), and where it communicates with the sac (Fig. 197, b). In both these situations, it will be found to be converted into fibro-cellular tissue; whilst between them there is an open space, through the medium of which the collateral circulation is freely carried on.



Fig. 197. — Portion of Artery ligatured for Popliteal Aneurism, after removal of the site of the Ligature, and at b, where the Tumour has become consolidated and absorbed between these points the Artery is open.

3. *Distal Ligature.*—In some cases in which the ligature cannot, for anatomical reasons, be applied on the proximal side of the aneurism, as in the arteries about the root of the neck, it was recommended by Brasdor that an endeavour should be made to obliterate the aneurism by ligaturing the vessel on its distal side. This operation was first practised by Deschamps, and has been especially commented upon by Wardrop. In principle, it resembles the Hunterian operation, the object being to arrest so much of the flow of blood through the sac that the consolidation of this may take place in the usual way, by the deposit of laminated fibrine. In the Hunterian operation, this is effected by deposit from the lessened quantity of blood that flows through the sac; in the distal operation, it is sought to be accomplished in the same way, and the success of the operation must necessarily depend, in a great measure, upon the extent to which the flow of blood through the sac is interfered with. This operation, however, is rarely successful; for, independently of the ordinary dangers resulting from the application of the ligature to a large vessel, the sac will continue to be distended with, and to receive the direct impulse of, the blood that is driven into it, though it be not transmitted through it; and hence, though the progress of the aneurism may be arrested for a time, it will often speedily increase again, and may perhaps eventually destroy the patient by suppuration and sloughing. I have collected the details of 27 cases, in which this operation has been practised, and of these I find that in 20 instances a fatal result speedily followed the operation; whilst in the remaining 7 cases the patient survived the effects of the ligature of the artery, though he was not at all cured of the disease for which the operation was practised. This operation, however, we shall consider more in detail in speaking of the particular cases in which it has been practised.

Indications and Contraindications of Ligature.—Ligature of an artery for aneurism, by the Hunterian method, succeeds best in those cases in which the tumour is circumscribed, of moderate size, slow in its growth, having a tendency to consolidation, and unaccompanied by much oedema of the limb. When the aneurism is undergoing spontaneous cure, no surgical interference should be employed, but the case left to nature. In this way it occasionally happens, during the preparatory treatment of the disease, that the aneurism becomes consolidated.

All operations should be avoided when there is any serious disease in the

heart, and in cases of multiple aneurism where the second tumour is situated internally; but it has happened that two aneurisms in one limb, as of the popliteal and femoral arteries, have been cured by one ligature applied to the external iliac. Two aneurisms seated in corresponding parts of opposite limbs, affecting, for instance, the two popliteal arteries, may be successfully operated upon. But, if two aneurisms be seated on different parts of the body, as the axilla and groin for instance, at the same time, the aneurismal diathesis would be indicated, and it would certainly not be expedient to operate.

In certain cases, the Hungarian operation seldom succeeds; and these, therefore, may be considered as unpromising to it. This happens in those instances in which it is necessary to apply the ligature very close to the sac, so as indeed rather to perform Auel's operation, as here there is the double danger of inflaming or wounding the sac, and of interfering with the collateral circulation of the limb. Those cases, also, in which the aneurism is very acute in its progress, increasing rapidly with forcible pulsation, having very fluid contents, and a large mouth to the sac, into which the blood is consequently driven by a full wave at each pulsation of the heart, are rarely favourable for the use of the ligature, inasmuch as stratification seldom occurs. When the aneurism is situated in the midst of loose and very yielding tissues, as in the axilla, where it readily expands to a large size, not being bound down by the surrounding parts, suppuration and sloughing of the sac are especially apt to occur after ligature. When it is diffused widely through the limb, with coldness and a tendency to incipient gangrene, the circulation of blood through the part is so much choked that the deligation of the vessel will in all probability arrest it entirely, and thus produce mortification. When arteries can be felt to be ossified, it is a question whether they can be safely ligatured, as in all probability they will be cut or broken through by the noose, and the changes necessary for their occlusion will not take place. Porter, however, recommends that the ligature should be applied in such case, though I cannot but doubt the propriety of this advice. When inflammation has been set up in the sac, with a tendency to suppuration of the tumour, it is a debateable question whether the ligature should be applied or not. In these cases I agree with Hodgson, that the artery should be tied; for even if the sac eventually suppurate, there will be less risk to the patient if this event occur after the application of the ligature, than if it happen while the artery leading into the tumour is pervious. If suppuration have already taken place in or around the sac, the application of the ligature above the inflamed tumour on the point of bursting would be worse than useless. In such cases, the line of practice must be determined by the seat of the aneurism. If this be in the axilla, groin, or neck, it should be laid freely open, the coagula scooped out, and the artery tied above and below the mouth of the sac—a most formidable and doubtful operation, but the only one that holds out a chance of success. If the aneurism be in the ham or calf, amputation would probably be the best course to pursue.

In some instances, there is no resource left to the surgeon, but to amputate. 1. Amputation must be performed when the aneurism is associated with carious bone, or diseased joint, as when popliteal aneurism has produced destruction of the knee. 2. If the aneurism have attained so great a magnitude that it has already interfered seriously with the circulation through the limb, as indicated by considerable œdema, lividity, and coldness of the part, with distension of the superficial veins, it is a question whether the application of the ligature may not immediately induce gangrene, and

whether the patient would not have the best chance of recovery by submitting to amputation at once; this is more particularly the case when the aneurism has become diffused with impending gangrene, when removal of the limb must not be delayed. 3. If gangrene have actually supervened and the patient's strength be sufficient to bear the operation, amputation should be done without delay. 4. If a diffused aneurism, whether suppurating or not, on the lower extremity, have been opened by mistake for an abscess, there is no resource left but immediate amputation.

The ligature fails from various causes in a very considerable number of the cases in which it is employed for the cure of aneurism. Thus, in the 116 cases of ligature of the larger arteries for aneurism, that have been collected and tabulated by Dr. Crisp, it would appear that the mortality amounted to about 22 per cent. And Porta finds that, among 600 cases of ligature of arteries for diseases and injuries of all kinds, the mortality amounted to 25 per cent. It must be borne in mind, that these are collections of previously reported cases, and that, if the unrecorded cases could be got at, the rate of death would, in all probability, be found to be much higher even than that above stated.

ACCIDENTS AFTER LIGATURE FOR ANEURISM.—The accidents that may follow the application of the ligature in a case of aneurism, are: 1, Secondary Hemorrhage from the seat of ligature; 2, the Continuance or the Return of Pulsation in the Sac; 3, the occurrence of Suppuration and Sloughing of the Tumour, with or without Hemorrhage from it; and 4, Gangrene of the Limb.

1. *Secondary Hemorrhage from the seat of ligature presents nothing peculiar, and has already been discussed at p. 178.*

2. *The Continuance or Return of Pulsation in an Aneurismal Sac after the ligation of the artery leading to it, is an interesting phenomenon, and one that deserves some attention.* When the Hunterian operation is successfully performed, though the pulsation in the sac be entirely arrested, a certain quantity of blood continues to be conveyed into and through it by the anastomosing channels, and it is from this that is deposited the laminated fibrine by which the consolidation of the tumour is ultimately effected. The stream of blood furnished by regurgitation, or by transmission through the smaller collateral channels, is continuous, and not pulsatory; occasionally, however, it is transmitted in sufficient quantity by some more than usually direct and open anastomosing or feeding branch, and thus gives rise to a continuance or to a return of the pulsation. It is interesting to observe that, in some of the cases in which this has happened, there has been a return of the bruit, but that in the majority no sound appears to have been emitted.

The *period* of the return of the pulsation in the sac after the ligation of the artery varies greatly. In by far the majority of cases, at least two-thirds of those in which it has happened, a certain degree of thrill or of indistinct pulsation has been found in the sac shortly after the application of the ligature; at all events within the last twenty-four hours. This may be looked upon as being rather a favourable sign than otherwise, as it is indicative of a free state of the collateral circulation, and generally soon disappears spontaneously, the sac undergoing consolidation. Next in order of frequency are those cases in which the pulsation returns in about a month or six weeks after the ligation of the artery, when the collateral circulation has been fully established, and, after continuing for some length of time, gradually ceases. It more rarely happens that the pulsation returns between these two periods; that is to say, about ten days or a fortnight after the application of the

ligature; though in some instances the slight vibratory thrill, scarcely amounting to a pulsation, which perhaps is perceptible a few hours after an artery has been tied, gradually strengthens at the end of a week or ten days into as distinct and forcible a beat as had been noticed before the operation. In some rare instances the pulsation has re-appeared after the lapse of some months, the aneurismal tumour having in the meanwhile undergone absorption, then indeed it may with justice be looked upon as constituting a *secondary aneurism*, and as indicating a recurrence of the complaint.

The cause of the continuance or of the return of the pulsation in an aneurismal sac, must be looked for in too great a freedom of the collateral circulation. Indeed, I consider it an essential requisite for the manifestation of this phenomenon, that there should be so free and direct a communication between the artery on the proximal side of the ligature, and that portion of the vessel situated between the ligature and the sac, or the sac itself, as to enable the impulse of the heart to be transmitted in a pulsatory manner into the tumour. No regurgitant blood coming upwards from that portion of the artery which is distal to the sac, however free it may be, can communicate an impulse, as it never flows *per saltum* except in the special case of a continuous circle of large anastomoses, such as are met with between the arteries within the skull, or in the palmar and plantar arches. If any of the direct collateral or feeding vessels happen to be sufficiently large at the time of the operation to transmit the wave of blood, the pulsation in the sac will be continuous, or will return almost immediately after the application of the ligature. If they be at first too small for this, they may become enlarged as part of the anastomosing circulation, and then the pulsation will return as soon as their calibre is sufficient to transmit the heart's impulse. Besides these conditions in the size and distribution of the vessels of the part, it is not improbable, as has been supposed by Porter, that certain states of the blood in some individuals may, from causes with which we are unacquainted, render it less liable to coagulate than usual, and thus dispose to a return of the pulsation in the sac, which remains filled with fluid blood.

The phenomenon under consideration has been noticed in all parts of the body after the performance of the Hunterian operation, though it occurs with different degrees of frequency after the ligature of different arteries, and is certainly of more common occurrence after operations for carotid aneurism than for any other form of the disease. Thus, of 31 cases in which the carotid artery has been tied for aneurism, I find that pulsation in the tumour continued or returned in 9 instances; whereas of 92 cases of inguinal aneurism, in which the external iliac artery was ligatured, the pulsation occurred in 6 cases only; and in several of these it is interesting to note that there were two aneurismal sacs in the same limb—one in the groin, the other in the ham; and that the pulsation, though permanently arrested in the popliteal, occurred in the inguinal aneurism. In the ham and axilla, pulsation occasionally though very rarely recurs. The cause of this difference in the frequency of the recurrence of pulsation in different aneurisms, is evidently owing to the different degrees of freedom of communication that exist between the sac and the collateral branches in various forms of the disease; thus, in a carotid aneurism, the impulse of the heart may at once be brought to bear upon the contents of the sac, through the medium of the circle of Willis. But, in the case of inguinal, femoral, or popliteal aneurism, the anastomoses, consisting rather of the inoculations of terminal branches than of open communications between large trunks, are less liable to transmit the blood in a pulsatory stream. For the same reason—the great freedom of the communication between the vessels of opposite sides—the pulsation has more fre-

quently been found to continue uninterruptedly and distinctly, though reduced in force, after the ligature of the artery, in carotid aneurisms, and in those in any other situation. The cases in which it returns after the cessation of a few hours only are perhaps as frequent in the groin and ham as in the neck. In those instances in which the pulsation returns within the first twenty-four hours after the ligature, it usually ceases again in a few days, though it sometimes continues a week or two. When it recurs at a later period, it is apt to last somewhat longer.

The prognosis of these cases is on the whole favourable, but few of them having eventually proved fatal. Of 26 patients in whom pulsation recurred, I find that 3 died; and in all of these the fatal result was occasioned by inflammation and sloughing of the sac. In all of the 3 instances, the pulsation recurred within the first twenty-four hours. When it returns at a more advanced period, there is little risk to the patient, as it is usually readily amenable to proper treatment.

A *Secondary Aneurism* is of extremely rare occurrence; indeed I believe there are only two unequivocal instances of this affection upon record, one of which took place in the ham; the original tumour having disappeared entirely after operation, the secondary disease made its appearance after a lapse of six months in one case, and in the other after four years. It is of importance to distinguish between a secondary aneurism and secondary or recurrent pulsation in an aneurismal sac. The term "*secondary aneurism*" should be restricted to those cases only in which an aneurismal tumour appears in the site of a former one, which has undergone consolidation and absorption after operation. The question may be raised, whether aneurisms of this kind are in reality secondary, or whether they may not originate in the dilatation of a portion of the artery contiguous to the seat of the former disease. It is certainly not very easy to understand how an aneurismal sac that has once undergone consolidation and absorption, can again become dilated into a pulsating tumour; and I think it most probable that, although the consecutive aneurism may be found in the same surgical region as the primary one, it in reality takes its origin from a slightly higher part of the artery, where the same structural changes may have been in progress that determined to the disease in the first instance at a lower point. Inside aneurism thus arising is, indeed, occasionally met with in the ham as a primary disease. I have seen a case in which an aneurismal tumour was situated in the ham, and another at or immediately above the aperture in the adductor muscle: if the artery in such a case as this had been tied before the second tumour had attained any magnitude, we can easily understand how, when this became dilated, it might have been considered to be a new enlargement of the original sac, whereas, in reality, it was nothing more than a new aneurism forming in the close vicinity of the old one.

The enlargement of an aneurismal sac without pulsation, after the ligature of the artery leading to it, is an interesting phenomenon, and one that might cause the true nature of the tumour to be misunderstood, as it closely resembles in its slow and gradual increase the growth of a malignant tumour. It is occasioned by the distension of the sac by the dark regurgitant blood brought into it through the distal end of the vessel, without sufficient force to cause pulsation, though with sufficient pressure to occasion a gradual increase in the size of the swelling.

Treatment of Recurrent Pulsation.—In by far the majority of cases of secondary pulsation, this phenomenon ceases of itself in the course of a few days or weeks by the consolidation of the sac, in the same way as after ligature of the artery, from the deposition of lamellated fibrine. This tendency

to consolidation of the tumour may be much assisted by means calculated to lessen the force of the impulse of the blood into the sac, such as rest, the elevated position, and the cautious application of cold to the part; cold, however, must be carefully applied, lest, as the vitality of the limb is diminished, gangrene be induced. At the same time, direct pressure may be exercised upon the sac, so as to moderate the flow of blood into it; this has in many cases succeeded in procuring consolidation of the tumour, and may most conveniently be applied by means of a compress and narrow roller. This plan is especially adapted to popliteal and inguinal aneurisms, but cannot so well be exercised upon those situated in the neck. Care must be taken that the pressure be not at first too powerful, lest gangrene result; the object is not so much to force out the contents of the tumour or to efface it, as simply to restrain and moderate somewhat the flow of blood into it.

In the event of the pulsation not disappearing under the influence of pressure, conjoined with rest, dietetic means, and the local application of cold, we must either perform the old operation of opening the sac, or amputate the limb. Of these measures, I should certainly advise amputation, as offering the most favourable chance to the patient. The operation of opening the sac, turning out its contents, and ligaturing the vessel supplying it, is under any circumstances a procedure fraught with the greatest danger to the patient, and full of difficulty to the surgeon, even when he knows in what situation to seek the feeding vessel. How much greater then must the difficulty be, when he is in uncertainty as to the point at which the artery enters the sac, and cannot know whether there be more than one arterial branch leading into it. In the event, therefore, of all other means failing, and of the pulsation in the tumour continuing, amputation is the only resource left to the surgeon.

3. *Suppuration and Sloughing of the Sac.*—When, after the ligature of its supplying artery, an aneurism is about to suppurate, instead of diminishing in size it increases, with heat, pain, pulsation, and some inflammatory discoloration of the skin covering it. This gradually becomes thinned, and at last gives way; the contents of the tumour, softened and broken down by the inflammatory action and the admixture of pus, are discharged through the aperture in its wall, in the form of a dark purplish-brown or plum-coloured and often fetid fluid, intermixed with masses of soft dark coagula, or of the drier laminated fibrine, which may not inaptly be compared in appearance to portions of raisins or dates. The escape of these matters, variously altered, may be accompanied or followed by the escape of florid arterial blood. This hemorrhage, which is the great source of danger in the suppuration of an aneurismal sac, may occur in a sudden or violent gush at the time of the rupture of the tumour, by which the patient may at once be destroyed; or it may continue in small quantities, which, after ceasing, recur from time to time, thus gradually exhausting the patient. It is this occurrence of secondary hemorrhage that constitutes the principal danger after suppuration of an aneurism, which otherwise is not a source of any very serious risk to the patient; about one-fourth only of the cases in which the sac has suppurated having had a fatal termination, and almost all those in which death resulted, having proved fatal by hemorrhage. The patients in the few remaining instances have been carried off by some special accidents, such as the pressure of the sac on the pharynx or œsophagus, or the discharge of the contents of the tumour into the pleura or bronchial tubes. Hemorrhage is more liable to occur when the suppuration takes place a few weeks after the ligature of the artery, than when a longer interval has elapsed. That

hemorrhage does not happen more frequently after suppuration of the sac, is very remarkable, and must be owing either to the sealing by adhesion or plugging by conglulum of the mouth of the aneurism, where it communicates with the interior of the artery. It is owing to this plugging also, that in many cases the fatal bleeding does not occur at the moment of rupture, but only after a lapse of some days ; or even weeks, and then most usually under the influence of some incautious movement of the patient, by which the conglulum or adhesion is suddenly disturbed. Those cases are most dangerous in which pulsation has returned in the sac after the ligature of the vessel, but before the supervention of suppuration ; as in these the tumour is so freely supplied with blood that, if it burst, fatal hemorrhage will with certainty supervene.

This accident is much more frequent in some situations than in others, and is more liable to occur in aneurisms of the axilla or groin, than in those of the ham or of the neck. The greater frequency of suppuration in axillary and inguinal aneurisms, is owing to the large size that these tumours rapidly attain, in consequence of the laxity of their cellular connections, and to the difficulty of their removal by the absorbents of the part. This accident is also greatly predisposed to, by the blood contained within the aneurismal tumour undergoing simple coagulation instead of fibrinous consolidation. The mass of conglulum, instead of being absorbed, and thus gradually disposed of, as happens in a properly stratified aneurismal sac, is very apt to break up and undergo decomposition, being converted into an unhealthy grumous fluid, which excites inflammation in the parts with which it is in contact. This state of things is especially liable to happen in those aneurisms that are of very large size, with thin parietes, and which contain, previously to the operation, much fluid blood and comparatively little laminated fibrine. In other cases it would appear that the fibrine, though properly deposited, acts as a foreign body, and gives rise to inflammation and suppurative action in the wall of the sac and the surrounding cellular tissue. Besides this, it has been very justly remarked by Porter, that the excessive handling and frequent examination to which an aneurismal tumour occurring in a hospital patient is usually subjected, may induce inflammatory action and give rise to suppuration.

The period at which suppuration of the sac may occur after the ligature, varies from a few days to as many months. In the majority of instances, it would appear to take place between the third and eighth weeks ; later than this it seldom happens, though it may do so after the lapse of several months, as in a case recorded by Sir A. Cooper, in which a carotid aneurism suppurred at the eighth month.

Treatment.—When an aneurism is suppurating, and is on the point of giving way, it will be better to make an incision into it, so as to let out at once the broken down and semi-putrefied contents. Its cavity must then be dressed like an ordinary abscess, with a view to its filling up by granulation ; which, however, will necessarily be a slow process, in consequence of the great size and depth of the opening. During the whole of this time a tourniquet should be kept loosely applied upon the artery above the sac, so as to be tightened at any moment that bleeding takes place. If hemorrhage have already supervened, the case is attended with immediate danger. In such a case as this, the first indication is clearly to arrest the immediate flow of blood, so as to prevent the patient from dying at once. This can best be accomplished by turning out the coagula and plugging the sac with lint or compressed sponge, retained *in situ* by a firm graduated compress, and well applied roller. The hemorrhage having thus been arrested for a time, the

surgeon should take into consideration what steps should be adopted permanently to restrain it. In some cases indeed, though these are exceptional, the plug and compress may be sufficient to prevent a recurrence of the bleeding; but in general it will not do to trust to these means, unless the anatomical relations of the part be such as to preclude the possibility of adopting any more active measures.

Various plans suggest themselves to the surgeon for the permanent suppression of the bleeding. The sac may be laid open, and an attempt made to ligature that portion of the artery from which the blood issues. But this can scarcely be expected to succeed, as, in the majority of the cases, the coats of the vessel being softened and pulpy, there would be little prospect of its holding a ligature, even if it were possible to expose it before the patient perished of hemorrhage. Indeed, though this plan has been several times tried, I am not aware that by it the surgeon has ever succeeded in arresting the bleeding from a suppurating aneurismal sac.

The application of the actual cautery to the bleeding orifice would, I think, hold out a better chance, more particularly if the blood were poured out from a collateral vessel of a small size. In this way Morrison, of Monte Video, succeeded in arresting the bleeding of an aneurism in the groin that had suppurated. Should this means, however, not suffice (and it is the only means that can be applied in many situations, as in the groin and axilla), there is no course left but, in those situations in which it can be done, either to ligature the artery higher up or to amputate. The application of a ligature nearer the centre of the circulation, even though practicable, appears to me to be of very doubtful utility; for the probability is, that the circulation through the limb, embarrassed as it must have been by the first ligature, and by the subsequent distension and suppuration of the sac, will be so much interfered with when the artery is tied a second time, that gangrene will result; or else that the collateral circulation, if sufficiently active to maintain the vitality of the limb, will also keep up the hemorrhage from the opening in the artery communicating with the sac. Under these circumstances, the only course left to the surgeon is amputation of the limb, when the aneurism is so situated that it can in this way be removed.

4. *Gangrene of the Limb.*—The general subject of gangrene of a limb, following injury and ligature of the main artery, has already been described (p. 183); and we have, at present, only to consider those cases in which it occurs after the operation for aneurism.

Cause.—If the aneurismal sac have attained a large size with great rapidity, it may, by its pressure on the anastomosing vessels, or on the veins in its vicinity (Fig. 198), produce such an amount of disturbance in the circulation of the limb, preventing the influx of arterial or obstructing the efflux of venous blood, as to occasion a great liability to the occurrence of gangrene. But perhaps the principal source of danger consists in the aneurism becoming evidently and widely diffused, more particularly in those cases in which the anatomical relation of the anastomosing vessels is such, as in the

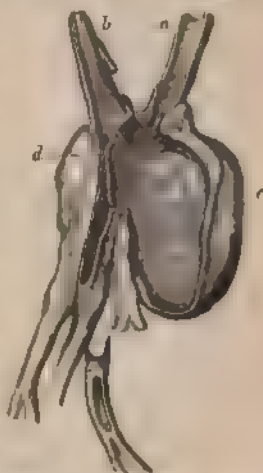


Fig. 198.—Popliteal Aneurism compressing the Veins and the Artery, causing Gangrene of the Limb. *a*, Artery. *b*, Vein, compressed at *d*. *c*, Aneurism.

ham, that they may readily and uniformly become compressed by the effused blood. In these cases, the additional embarrassment induced in the circulation of the limb by the ligature of its main artery will readily induce gangrene; and hence it is that, in diffuse aneurism of the lower extremity, ligature of the artery is so commonly followed by mortification.

The loss of blood, either in consequence of secondary hemorrhage, or in any other way before or after the application of the ligature, is very apt to be followed by gangrene; the more so, if the state of things have rendered it necessary to apply a ligature to a higher point on the trunk of the vessel than had previously been tied. This secondary ligature of a large artery in cases of aneurism has, I believe, been invariably followed by gangrene of the limb when done in the lower extremity; the interference with the collateral circulation by the second ligature being so great, that the vitality of the part cannot be maintained.

Besides these causes, the occurrence of *erysipelas*, exposure of the limb to cold or to an undue degree of heat, or subjecting it to the compression of a bandage, may be attended by consequences fatal to its vitality.

The period of *supervention* of gangrene of the limb is usually from the third to the tenth day; it seldom occurs before this period, unless incipient mortification have already set in before the artery is tied. Gangrene usually follows the ligature of the external iliac at an earlier period than that of any other artery. In cases of aneurism, the gangrene is always of the dark and moist variety, owing to its being commonly dependent on pressure upon the large venous trunks by the aneurismal tumour.

Treatment.—The general preventive treatment of gangrene dependent on the ligature of the artery for aneurism must be conducted on the same principles as when it arises after the ligature of arteries generally. But some special modifications of it are required, so far as the aneurism is concerned. When the gangrene occurs from the pressure of the sac upon the accompanying vein, it has been proposed to lay the tumour open, and to turn out its contents, thus removing the compression exercised by it. The danger of such a proceeding consists in the probability of the occurrence of hemorrhage from the opening made into the sac, and in the risk attending suppuration set up in this; yet it would appear that, in two cases in which this practice has been adopted, no bad results followed. Thus, Lawrence has related a case of diffused aneurism of the popliteal artery, in which this plan was had recourse to with the best results; and Benza (*Medical and Physical Journal*, vol. lv.) has recorded a case of popliteal aneurism in which the same practice was adopted in consequence of great oedema and incipient gangrene of the foot; after the extraction of a quantity of flesh-like fibrine from the sac, the patient made an excellent recovery. These cases would certainly justify the surgeon in adopting such a course when the danger of gangrene is imminent, and dependent on the size and pressure of the tumour. Should, however, the gangrene show any disposition to extend, or should there be hemorrhage from the sac after it has thus been laid open, the surgeon must hold himself in readiness to amputate without delay. When gangrene has once fairly set in, there is no reasonable prospect of saving the limb; and the sooner amputation is done, the better. The limb must always be removed high up above the sac, and, if possible, not only at some distance from the parts that have mortified, but above the limit to which the serous infiltration that precedes this condition has extended. The upper extremity must generally be removed at the shoulder-joint; the lower, above the middle of the thigh. In these cases there will generally

be a considerable amount of hemorrhage, and many vessels will require to be tied in the stump, in consequence of the enlargement of the collateral circulation.

COMPRESSION BY INSTRUMENTS—In consequence of the dangers and difficulties attendant upon the use of the ligature, surgeons have for many years past endeavoured to treat aneurism by compression. The employment of direct pressure on the aneurism was almost naturally suggested as a means to counteract the extension of the disease by the pressure of the blood from within, and has consequently been applied from a very early period in the treatment of the affection. This plan of treatment was first employed by Boudolot at the close of the seventeenth century; afterwards by Genga, Heister, Guattani, and others. These surgeons made the pressure directly upon the sac; and Guattani and Flajani relate several cures that they effected in this way; but the method was so uncertain in its results, and so dangerous, from irritating and inflaming the sac, that it fell into disuse. The French surgeons introduced a modification of the pressure plan, by laying open the sac, clearing out its contents, and applying the pressure directly over the ends of the vessel. Deschamps exposed the artery leading to the sac, and compressed this with an instrument he termed the "*prosse-artere*." These barbarous modes of treatment, however, were entirely set aside by the facility and comparative success of the Hunterian operation; and compression in aneurism was rarely practised by surgeons after the great step made by John Hunter in the treatment of this disease. Yet we find that John Hunter himself, Blizard, and Freer attempted, though with but little success, to cure this disease by pressure on the artery leading to the sac. Pelletan and Dubou appear to have been the first who employed the pressure upon the artery above the sac, instead of upon the aneurism itself; this was in 1810. Since this period various attempts were made methodically to treat aneurisms in this way; but the merit of having introduced the practice of compression in the treatment of aneurism into modern surgery, of having given it a definite place in our art, and of having established the true principles on which it acts, incontestably belongs to the Dublin surgeons; amongst whom the names of Hutton, Bellingham, Tufnell, and Carte deserve especial mention.

Principle.—In the early trials of the cure of aneurism by compressing the artery on the cardiac side of the tumour, the surgeons who employed this method acted on an erroneous theory; and, the principle not being understood, the practice was bad. It was supposed that it was necessary, in order that the cure might take place, that the *whole* flow of blood through the artery should be entirely arrested; that inflammation of the vessel at the point compressed should be set up; and that the consolidation of the aneurism depended upon the obstruction of the vessel consequent upon this inflammation. This led to compression being exercised so forcibly, with the view of exciting inflammation in the artery, that the patient could seldom bear it for a sufficient length of time to effect a cure; sloughing of the skin commonly resulting as a necessary consequence of the severe pressure to which it was subjected. To the Dublin surgeons belongs the very great merit not only of having pointed out the error of this doctrine, but of having distinctly laid down as the principle of the practice, that the aneurism was cured, when the artery leading to it was compressed, in precisely the same way as when a spontaneous cure takes place, or when the Hunterian operation is performed—viz., by the deposit of stratified fibrine in the sac, and by the consequent consolidation of this (Fig. 199), aided by the contraction of the walls of the sac; and that, as in the case of ligature of the vessel, it

was not necessary for the whole of the circulation through the artery to be entirely and permanently arrested, but merely for it to be lessened in quan-



Fig. 190.—Sac of Aneurism cured by Compression. Deposit of Laminated Fibrine.

tity and force to such an extent as to be compatible with the deposition of laminated fibrine in the sac; and it was clearly shown by examination after death that, if the pressure were properly conducted, the artery was in no way injured or occluded at the part compressed. This recognition of the true principles on which compression of the artery leading to the sac cures the aneurism, has led to important results; for, as the severe pressure that was formerly considered necessary is now known not only to be useless, but to be absolutely injurious, no amount of compression is exercised beyond what is requisite to restrain and moderate the flow of blood into the sac; no attempt being ever made to compress the artery so severely as to lead to its obliteration by inflammation.

Though I have stated generally that aneurisms, when treated by compression, are cured by the deposit of laminated fibrine, I think this remark ought to be confined to the common sacculated form of the disease. In the tubular variety, which is certainly of far less frequent occurrence in the extremities, the cure of the aneurism takes place by contraction of the sac, and by its becoming filled by fibrine in a somewhat irregular manner. Illustrative of this mode of cure, there is a preparation in the Museum of University College (Fig. 200).



Fig. 200.—Sac of Tubular Aneurism cured by contraction. Deposit of Fibrine.

Circumstances influencing Success.—The success of the treatment by compression depends greatly upon a scrupulous attention to a number of minor circumstances, which, though each be trivial in itself, become of importance when taken as a whole. During the whole of the treatment, also, the patient's general health should be attended to in accordance with those dietetic and medical principles that have already been laid down in speaking of the constitutional treatment of the disease, having for their object the increase of the fibrination of the blood. The irritability of the heart and arteries must also be subdued, and the irritation of the system lessened, by the use of opiates; and the patient should be put into a comfortable bed, with firm and well-secured pillows and mattresses, so that his position may not be changed. As it is principally in aneurism of the lower extremity that compression can be employed, we shall proceed to describe the method of its application here.

Application of the Compressor.—The limb having been bandaged smoothly, with a soft cotton or air-pad upon the tumour, and laid comfortably on pillows, the thigh should be shaved, and dusted with hair-powder. The apparatus must next be applied; and much of the success of the treatment will depend upon the kind of instrument used. The ordinary horse-shoe, or Sigoroni's tourniquet, was the one first employed, and this will, in many cases, answer the purpose perfectly well; but, as it is somewhat difficult to regulate the pressure with this instrument, and as it is not unfrequently exercised too powerfully, it has generally given place at the present day to the very ingenious apparatus of Dr. Carte, which, as it substitutes an elastic force derived from vulcanised India-rubber bands for the unyielding pressure of the screw, accommodates itself better to the limb, and is less likely to

produce injurious compression. This instrument, as well as the other contrivances which have at various times been invented for the treatment of aneurism by compression, are described by Dr. Bellingham and Mr. Tufnell, in their works on this subject, to which I must refer for a fuller account than I can here give. In some cases the circulation through the artery may conveniently be controlled by the pressure of a weight laid over it in the groin as it passes over the pubes; usually from a four to a seven pound weight is sufficient for this purpose. In this way, when only one compressor is applied on the limb, the flow of blood may be checked during the time that the screw is loosened. Care must of course be taken that the weight do not slip off. It is best made of lead, cast in a conical shape, and may be retained *in situ* by having a wide leather socket made to fit it, shaped somewhat like the hopper of a mill; its broad end should be upwards, and the narrow end should press on the vessel.

In applying the compressor, especial care must be taken that it is well padded in every part, so as not to gall the skin. In some of the early cases in which I saw compression employed in London by means of the horse-shoe tourniquet, much inconvenience resulted from want of attention to this particular. The tendency to fretting of the skin is much lessened by powdering the limb; and the removal of the cuticular hairs by shaving, diminishes materially the irritation produced by the instrument. In order to keep up continuous pressure, and at the same time to prevent any one part of the skin from being injuriously galled, it is of very great consequence that two instruments should be used at the same time, so that when one is screwed up the other may be loose; these instruments need not be placed closely together. If the aneurism be in the ham, it will be sufficient for one (Fig. 201) to be applied to the groin, whilst the other (Fig. 202) is put

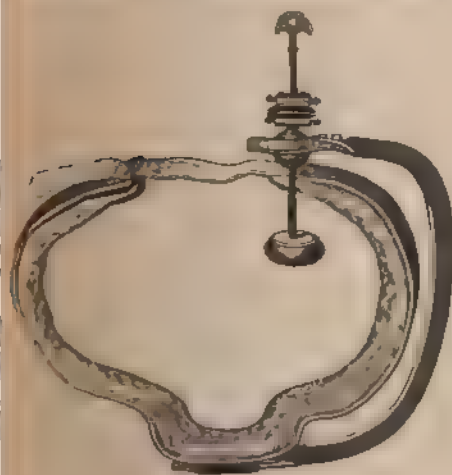


Fig. 201.—Compressor for the Groin.

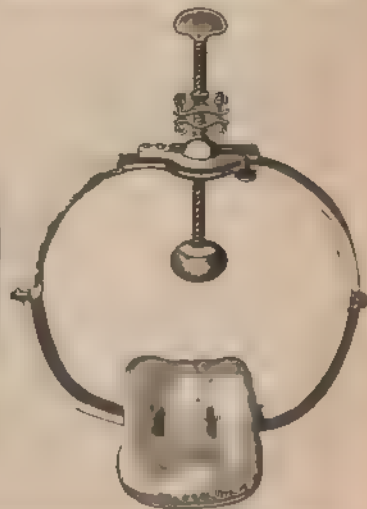


Fig. 202.—Compressor for the Middle of the Thigh

upon the middle of the thigh. In using the instrument, the great point, as Tufnell most properly remarks, is to control the circulation with the minimum of pressure. In order to do this, the first instrument should be screwed up so that all pulsation ceases in the tumour, but still not so tightly as completely to arrest all the flow of blood through it. As the pressure

exercised by this becomes painful, the second one must be screwed tight, and then the first compressor may be slackened. In this way an alternation of pressure can be kept up without much pain or inconvenience. If possible, the patient should be taught how to manage the instrument himself, and will often find occupation and amusement in doing so. If, however, it excite much pain or irritation, as it does in some subjects, it may be necessary to give opiates. The pressure should, if possible, be continued during sleep; but, if it prevent the patient from taking his natural rest, the suggestion made by Tufnell, of unscrewing the instrument slightly, and, when the patient is asleep, gently tightening it again without awakening him, may advantageously be adopted; it is indeed surprising how very little unscrewing will relieve the pain of the compression. A large cradle should be placed over the patient's body, so that the weight of the bed-clothes may be taken off the apparatus, and that the patient may manage it without risk of disturbance. Should there still be much uneasiness, the instrument might be taken off for a few hours, and compression kept up in an intermittent manner. Even under such circumstances as these, consolidation of the sac may ensue.

The *Effects* upon the tumour vary considerably. In some cases it rapidly and suddenly solidifies; more commonly, however, this is a gradual process, the aneurism becoming more painful and solid, with less pulsation and bruit. As the solidification takes place, there is usually a good deal of restlessness, a feeling of general uneasiness, and of constitutional disturbance, which is best quieted by opiates. As the pressure is continued, and the tumour begins to harden, the anastomosing vessels enlarge, with a good deal of burning pain in the limb generally, and arterial pulsations in situations where usually none are felt. The abnormal pulsation, in these cases, is always found to occur in much the same situations, the same vessels appearing to undergo dilatation. Thus Tufnell has made a remark, which I have had more than one opportunity of verifying, that in the treatment of popliteal aneurism by compression, three arteries will be found to be enlarged, one of which passes over the centre of the tumour, another over the head of the fibula, and the third along the inner edge of the patella; he also states that the severe burning pain which is felt in these cases is owing to the artery accompanying the communicans peronei nerve being enlarged. After complete solidification of the tumour has taken place, the compression ought to be continued for at least forty-eight hours, so as to secure against the occurrence of a relapse.

The *Duration* of the treatment varies very greatly. In some cases the tumour has become solidified in a few hours or days. The shortest period in my own practice in which the aneurism has been cured, has been six days. In other instances, the treatment has required to be protracted for more than three months before a cure resulted. Of 26 cases of femoral or popliteal aneurism cured by compression in the London hospitals, the average time, according to Mr. Hutchinson, was nineteen days. Much of course will depend, in this respect, on the constitution of the patient, and on the condition of the tumour; those circumstances which are most favourable to the spontaneous cure of the aneurism will also influence the rapidity of the cure by compression.

Applicability.—Of the great value of compression in the treatment of aneurism there can be no doubt; yet it cannot be looked upon as taking the place of the ligature in the cure of this disease, except in those cases in which the tumour is situated in the arteries of the lower extremity below the middle of the thigh. In aneurisms occurring in the vicinity of the

trunk, as in the iliac, the carotid, subclavian, and axillary aneurisms, is quite inapplicable. Spontaneous aneurism is extremely rare in the lower extremity, and, as the traumatic forms of the disease which are generally required that the sac should be destroyed, it is seldom necessary to have recourse to it in this part of the body, though it has been successfully applied to the brachial artery.

The great question with regard to compression arises in the selection, to be whether it possesses any special advantages over the ligature in the treatment of femoral and popliteal aneurisms, to which its employment is commonly chiefly confined. The principal objections that have been urged against compression are, that its employment is more painful and tedious than the use of the ligature; and that those cases that are amenable to the ligature or that require amputation rather than it, are equally amenable to compression, and cannot be saved by the latter method.

To these objections I think it only with justice to answer, that the pain attendant on the employment of compression depends very much on the skill and care with which the operation is applied, and on the management, as well as upon the kind of instrument used, being certainly much diminished when Cartes's elastic compression is employed. With regard to the relative tediousness of the treatment under the two plans, I would appear that in reality there is but little difference: for although some cases, in which compression is used, are protracted over a considerable space of time, yet they do not occupy more than is often consumed when aneurisms of various kinds follow the use of the ligature, and in yet more many happens in compression, but can never occur after the employment of the ligature, that the patient is cured of his disease in a few days or two. Taking, however, the averages, we find that in the London cases the treatment lasted twenty-five days, and in the recent London cases one and nineteen, and this is not very different from what happens with the ligature, for, of 54 cases recorded by Crisp, in which the femoral artery was tied, the average time for the separation of the ligature was eighteen days, and if to this a week more be added for the closure of the wound, and for the treatment of the various accidents so often accompanying, and following, ligature, we should probably be within the mark, and yet only bring the duration of the treatment of the two methods to the same level.

After all, surgeons will eventually be guided in their estimate of the value of these two plans, not so much by the question of submitting their patients to a slightly more painful or tedious treatment, as to the comparative risk of life attendant upon one or other method. Upon this point the statistics have yet to be made; partly because cases of the treatment of aneurism by compression have not yet been sufficiently numerous, and partly because the unsuccessful cases of ligature have not been so commonly published as the successful ones. If, however, we compare the 32 cases of femoral and popliteal aneurism treated in Dublin up to February, 1851, as given by Dr. Bellingham (*Med.-chirurg. Transactions*, vol. 34), with the results of 188 cases of femoral and popliteal aneurism, recorded by Verreaux, in which the artery was ligatured, we shall find that of the 32 compression cases 26 were cured; in 1, the ligature was applied after pressure had failed, in 2, amputation was performed, in 1, death occurred from erysipelas, in 1, from chest-disease; and in 1 case the pressure was discontinued. Thus it would appear that 6 out of the 32 failed, being in the proportion of 1 to 5.3 cases, and 2 died, being in the ratio of 1 to 16. Of the 188 cases in which the artery was ligatured, 142 were cured, 46 died, 7 were amputated, in 10 the sac suppurated, and in 2 gangrene of the foot

occurred. Thus the deaths after ligature were in the proportion of 1 to 4, and the failures or serious accidents in that of 1 to 3, showing clearly a very considerable preponderance in favour of the treatment by compression. Besides this, in many patients who recovered after the ligature, various accidents, such as gangrene, erysipelas, secondary hemorrhage, &c., resulted as the direct consequences of the treatment; and these do not happen when pressure is employed.

If compression fail, ligature may often be advantageously applied; and, as has been shown by the known cases, with a better success than if compression had not previously been tried, that treatment having caused the collateral circulation to enlarge, and thus lessened the tendency to gangrene.

It should also not be forgotten that in some cases, such as when aneurism is complicated with heart-disease, or occurs in a very broken and unhealthy constitution, in which the operation necessary for the application of the ligature would scarcely or not at all be admissible, compression may be safely employed.

After carefully considering the relative merits of the two plans of treatment, I think we may conclude that, though in some few cases neither ligature nor compression can be adopted, and amputation is the sole resource, yet in others compression can be employed when it would not be safe to have recourse to the use of the ligature; and that in all ordinary cases of femoral and popliteal aneurism especially, compression should be preferred to the ligature, inasmuch as it is not a more tedious, and an infinitely safer method of cure. At the same time, it must not be forgotten that its success depends very greatly on the continuous care bestowed upon the case during the progress of the treatment.

FLEXION.—The treatment of aneurism by compression has of late been much simplified, and all apparatus dispensed with, by two methods; in one of which the artery and aneurism are compressed by the *flexion* of the contiguous joint, while in the other the artery is compressed by the finger alone.

The treatment of aneurism by the flexion of the contiguous joint is, of course, applicable in those cases only in which the disease is situated opposite to and inside the flexure of a joint, as in the popliteal cavity, at the bend of the arm, and possibly in the axilla. It is in cases of popliteal aneurism that this method of treatment is specially applicable; and the merit of first successfully employing it in this disease is undoubtedly due to Mr. Hart.

Nothing can be simpler than this plan. It consists in flexing the leg upon the thigh, so that the heel is brought up towards the buttock, where it is retained by a strap or bandage. The patient is at the same time confined to bed, and put under proper constitutional treatment. By this means, the popliteal artery being bent at an acute angle, the circulation through it is nearly, if not completely arrested; and the obstacle to the flow of blood is still further increased by the compression of the tumour between the posterior flat surface of the femur and the upper part of the calf. In this way the aneurism is most favourably situated for the consolidation of its contents, which, in the cases recorded, has taken place at an early period.

In order that this plan may be successfully carried out the limb should be bandaged, and then at first gently flexed, the bending being gradually increased as the patient can bear it. Great care should be taken not to make the flexion too forcible at first, and not to place the limb in a position that would be irksome or painful to the patient. The principle on which

the cure is effected in these cases appears to be, that by flexion the artery leading to and from the sac, and the aneurism itself, are so compressed that retardation of the circulation ensues, and deposition of laminated fibrine takes place in the usual way.

The compression by flexion, like every other method of treating aneurisms, occasionally fails. It is most likely to be attended by success in those cases in which the aneurism is small, situated low in the popliteal space, and in a young or middle-aged subject, who can bear the continued flexion without much inconvenience.

The good effects of flexion would probably be much increased by the simultaneous employment of digital compression. Should this method of treatment fail, compression by instruments or the ligature can be had recourse to as readily as they might have been in the first instance.

DIGITAL COMPRESSION.—The treatment by *digital compression* was first employed by Dr. Vanzetti of Padua. In this plan of treating aneurisms no apparatus of any kind is used; but the circulation through the artery leading to the tumour is controlled by the pressure of the finger. In order to carry it out efficiently there must be relays of assistants, each one of whom compresses the vessel for about ten minutes at a time. So soon as his fingers become fatigued, but before he relaxes the pressure, another assistant compresses the vessel; and thus the circulation through it may be uninterruptedly controlled. In this way aneurisms of the popliteal artery, in the orbit, at the bend of the arm, and even, it is said, in the groin, have been successfully treated—the tumour having in some instances become consolidated in a few hours. The effect of the treatment, and the rapidity of cure, would be increased by the application of direct pressure to the tumour, or by manipulation and by the previous employment of proper constitutional means. It might be very advantageously conjoined with the treatment by flexion; but its great advantage seems to be, that it is applicable to arteries at the root of the neck, to which it would not be possible to apply any kind of compressor, or when the surgeon is so placed as not to be able to obtain such an apparatus.

MANIPULATION.—Mr Fergusson has proposed to treat some aneurisms by a procedure which he terms *manipulation*. This consists in squeezing the aneurismal tumour in such a way as to detach a portion of the coagulum within it, which, being carried on with the current of blood into the distal end of the artery, obstructs this; and thus, by impeding the circulation through the sac, may lead to the gradual consolidation of the tumour. This procedure has as yet been employed to too limited an extent to enable us to form an estimate of its value, and can scarcely be considered, nor is it intended to be, of very general application. To aneurisms, however, that are not amenable to ordinary surgical treatment, and that must necessarily prove fatal if left, as those situated at the root of the neck, more particularly of the subclavian artery, it might possibly be advantageously applied. It is scarcely necessary, however, to point out the obvious danger of rupture of the sac, or of the diffusion of the aneurism on the separation of the coagulum, to make surgeons adopt due caution in carrying out this method of treatment. There is another danger also especially attendant on this procedure, when applied to aneurisms about the neck; viz., that the detached coagulum may be carried by the circulation into the cerebral arteries, and by obstructing them occasion the same kind of cerebral disturbance that occurs when these vessels become occluded by fibrous plugs—embolia. That this danger is a real and a great one, is evident from the fact that, in several cases in which manipulation of subclavian and carotid aneurisms has been tried, the patient

has been suddenly seized with syncope and hemiplegia. Mr. Trevis has successfully conjoined manipulation with compression in a case of popliteal aneurism, in which the pressure on the artery was slow in consolidating the tumour; the detachment of a portion of the coagulum almost at once led to the consolidation of the tumour.

GALVANO-PUNCTURE.—The attempt to procure consolidation of an aneurismal sac by the employment of electricity or galvanism is of comparatively recent date. It appears to have been first practised by Mr. B. Adams about the year 1832. Little attention, however, was given to this method of treatment until a few years back, when it was revived by some of the French and Italian surgeons, especially by Pétrequin and Burel. The principle on which this operation is conducted consists in endeavouring to procure coagulation in the aneurismal sac, by decomposing the blood contained in it by means of the galvanic current. In some instances the attempt to do so has induced inflammation of the sac and of the surrounding structures, and in all it must occasion the liability to this, as the change that it brings to be effected in the contained blood, consists not in the deposition of a fibrine, but in the coagulation of it *en masse*. It has of late been recommended to conjoin the employment of compression of the artery, either above or below the sac, with the transmission of the galvanic current through it, there being in this way less liability for the coagulum that is deposited to be broken down and washed away, than would happen if the contained blood were allowed to pass through the sac whilst it is in the act of forming.

The coagulation of the blood is effected by introducing two acupuncture needles into the sac in opposite directions, and keeping them in contact with one another, after connecting them with a galvanic battery of moderate tension; coagulum becomes deposited around one of the needles. The operation should be continued for periods varying from ten minutes to a quarter of an hour, and requires to be repeated several times. Pétrequin recommends that the direction of the current be changed from time to time, so that a number of clots may be formed in the sac. In this way a solid mass of coagulum may occasionally be formed in the tumour, so as to fill it up more or less completely, and to prevent the passage of blood through it. Occasionally it happens, however, that the blood has continued fluid, and the sac pervious, no coagulation having been effected; and in other instances, the amount of inflammation that has been set up in the sac has been so great as to give rise to its sloughing, to the occurrence of secondary hæmorrhage from it, and to the loss of the patient's limb or life. This inflammation may, in some cases, doubtless, have been the result of the injury inflicted upon the sac by the introduction of the needles, and by the charring of the tissues by them; but, in other cases, I think it probable that it may have taken place from the rapid coagulation of the contained blood, as occurrence which, as we have already seen, tends especially to inflammation, suppuration, and sloughing of the aneurismal sac. The pain of the operation is always very considerable; so much so, that patients who have been subjected to it once have refused to submit to a repetition of it.

Up to July, 1851, M. Bonnet had collected 23 cases of aneurism treated in this way; of these, 8 were of the brachial artery, 7 of the popliteal, 2 of the subclavian, and 1 of each of the following: the ophthalmic, the temporal, the carotid, the thoracic aorta, the ulnar, and one unknown. Of these the proceeding failed in 13 instances; 9 cases were reported as successful, but in 7 of these M. Bonnet states that doubts must be entertained both as to the results and as to the treatment, for the cure took place not by galvanism.

puncture alone, but in some by the conjoined influence of compression and the application of ice; and in others as the result of inflammation and supuration of the sac. There are consequently only two cases in which the cure can clearly be attributable to this means alone, and without the occurrence of any serious accident.

When we compare galvano-puncture with ligature or compression, in the treatment of external aneurism, it is, I think, impossible to hesitate for a moment in giving a decided preference to the latter modes of treatment. Not only is the principle on which it is attempted to procure obliteration of the sac in galvano-puncture a vicious and peculiarly dangerous one, viz., the coagulation of the blood, and the inflammation of the wall of the sac; but the results that have hitherto been obtained by this method are not such as would justify a prudent surgeon in submitting his patient to experiments of this kind, when he possesses so certain and comparatively safe modes of cure as those by deligation or compression. In internal aneurisms, or in those cases in which the disease is so situated at the root of the neck, that the artery can neither be ligatured with safety or compressed, galvano-puncture may perhaps be employed with some advantage, in conjunction with proper medical treatment.

INJECTION WITH PERCHLORIDE OF IRON.—The injection of aneurismal sacs with a solution of the perchloride of iron has also been practised, with the view of coagulating their contents; such treatment, however, is not only coarse and unscientific, but dangerous, and, when compared with the ligature or compression of the artery leading to the sac, must be looked upon as a retrograde step in surgery.

ARTERIO-VEINOS ANEURISM.

Preternatural communications between arteries and veins, though usually the result of wounds, occasionally happen from disease; ulceration taking place between the vessels, and thus causing an aperture to lead from one into the other. When such communications are of a traumatic character, they may, as has already been stated, constitute either an *Aneurismal Varix* or a *Varicose Aneurism*. As the result of disease, aneurismal varix only can occur, varicose aneurism never happening except as a consequence of wound. These spontaneous communications have been met with between the aorta and the vena cava, and between the iliac, femoral, carotid, and subclavian arteries and their accompanying veins. In nature, symptoms, course, and treatment, they so closely resemble traumatic aneurismal varix, described at page 189, that their consideration need not detain us here.

SPECIAL ANEURISMS.

CHAPTER XLII.

ANEURISMS OF THE THORAX, HEAD AND NECK, AND UPPER EXTREMITY.

ANEURISM OF THE THORACIC AORTA.

SYMPTOMS.—The symptoms of Intrathoracic Aortic Aneurism are of two kinds : *auscultatory* and *rational*.

The *Auscultatory Signs* vary greatly in distinctness, and even in presence. In some cases, more especially in fusiform aneurisms, they are almost from the first of a very marked and obvious character ; in others, especially in sacculated aneurisms, they are absent throughout, the aneurism terminating fatally without its existence having been determined by the stethoscope. They consist in murmurs of various kinds and degrees of intensity, bellows, rasping or whizzing ; in the second sound of the heart being audible over a greater space than normal ; and in the existence of dullness on percussion. These various signs may often be heard more distinctly upon or to the left side of the spine, than at the anterior part of the chest ; when occurring anteriorly, they are chiefly met with on the right side.

The value of the auscultatory signs in the diagnosis of aneurism within the chest is not perhaps so great as in many other thoracic diseases, in the early stages of the affection, and in those cases in which the aneurism continues small and sacculated throughout, or is so deeply seated as not to approach the parietes of the chest. This need not be a matter of surprise, when we reflect how deeply the ascending portion of the aorta and the arch are situated ; how they are covered in front by the lungs and loose cellular tissue, through which sound is with difficulty transmitted ; and how they are covered in behind by the spine and its muscles. When, in addition to this, it is borne in mind that aneurisms of the arch often prove fatal by bursting into contiguous cavities and canals before they have attained a greater size than a walnut or a pigeon's egg, and thus are incapable of furnishing a murmur of any very marked kind, it can be easily understood that the value of auscultation is but small in many cases of thoracic aneurism.

The *Rational Signs* of intrathoracic aortic aneurism are of three kinds .— Pressure Effects ; Pulsation ; and Tumour.

Pressure-Effects may be exercised on any of the contiguous structures ; and a glance at the anatomical relations of the thoracic aorta, more particularly the arch, will enable the surgeon to judge of their complexity and importance. They will necessarily vary according to the size of the aneurism and the portion of the aorta affected by it ; more according to the latter than the former condition. When the aneurism arises from the *root of the aorta*, and more especially when it is intrapericardial, it is usually of small size, and its pressure-effects will be little obvious. When the aneurism arises from the *termination of the arch*, or the *descending aorta*, it may often attain a considerable amount of development without any very obvious

pressure-effects being induced. Aneurisms that are situated *within the concavity of the arch* necessarily give rise to very severe effects, by the compression they must exercise upon some one or other of the very important structures that are spanned by and included within the aortic arch. When the *anterior part of the aorta* is affected, the aneurism may attain a very considerable bulk, even coming forward so as to project and pulsate between the intercostal spaces, without any very noticeable pressure-effects being induced. But when the *posterior wall of the artery* is the seat of the disease, then severe symptoms are early set up by the compression of the structures lying contiguous to the artery and along the spine. When the *upper part of the aortic arch* is the seat of aneurism, a peculiar train of cerebral symptoms, such as vertigo, insensibility, or defective vision, may be induced by its interference with the circulation through the carotids.

The pressure-effects that need chiefly engage our attention, are:—1, Pain; 2, Dyspnoea; 3, Dysphagia; and 4, Edema.

1. *Pain* is usually one of the earliest symptoms of intrathoracic aneurism, and is often of great value in a diagnostic point of view, as it is often most marked when the other symptoms are the least developed. It is generally more severe in sacculated than in fusiform aneurisms, and when the posterior rather than the anterior aspect of the vessel is the seat of disease. The pain, as has been pointed out by Dr. Law, is of two distinct kinds. The first kind is lancinating, intermittent, and neuralgic in its character, evidently dependent upon pressure on the spinal or sympathetic nerves. This pain is chiefly seated on the left side, and shoots up the side of the head and face, along the upper arm to the elbow, along the intercosto-humoral nerve, through the chest, or between the scapulae. The second form of pain usually occurs at a later stage of the disease, is continuous, and of a boring, hot, or burning character. It seems to depend upon the perforation of the tissues, more especially the bones, by the aneurismal tumour, and chiefly occurs on the right side of the chest.

2. *Dyspnoea* is of very frequent occurrence in intrathoracic aneurism; in all probability it is more uniformly met with than any other single symptom. It may arise from five distinct conditions, and its characters vary with its cause.

a. *From direct pressure on the trachea.* In these cases the dyspnoea is attended by much and constant wheezing, cough, often by whistling sounds in the chest, and by slow expansion of that cavity. There is usually expectoration of thick tenacious or ropy mucus.

b. *From direct pressure on a bronchus.* In these cases there are wheezing, cough, and some degree of expectoration, with perhaps diminished respiratory murmur in the side affected, and puerile respiration in the opposite lung, as has been pointed out by Dr. Stokes.

γ. *From pressure upon the lung.* In these cases the respiration is comparatively little interfered with, the spongy tissue of the lung accommodating itself and yielding to the pressure of the tumour. After a time, the pulmonary tissue will become incorporated with the wall of the sac; and then more serious difficulty in breathing, with hemoptysis, will supervene.

δ. *Dyspnoea* may be, and very commonly is, induced by *irritation, compression, flattening out, or stretching of the left pneumogastric and recurrent laryngeal nerves*, by the pressure of the tumour. In these cases the larynx becomes the seat of the difficult respiration, its muscles being driven into a state of spasm, so as to occasion paroxysmal attacks of intense difficulty of breathing.

The voice becomes hoarse, croupy, or croaking; the cough has a loud *crepitant* or metallic sound, and is attended by the expectoration of thin frothy mucus. The laryngeal spasm and stridor often do not occur in ordinary respiratory disease, but are produced under exertion, or in making the patient inspire fully and deeply. The laryngeal symptoms are sometimes so much more prominent than any of the other signs of intrathoracic aneurism, and so closely resemble chronic or even acute laryngitis, with impending asphyxia, that there are in a few cases in which surgeons have performed tracheotomy, on the supposition that they had to do with cases of pure and uncomplicated laryngeal disease, and in other instances this operation has been performed with the view of prolonging life, even when the dependence of the laryngeal spasm on aneurism of the aorta has been recognised.

4. Dyspnoea may be dependent on the compression of the pulmonary vessels by the aneurismal tumour. In cases of this kind there would be considerable lividity of surface, and signs of pulmonary congestion.

The dyspnoea of aneurism will often be sufficiently intense to occasion death. It may be mistaken for ordinary asthma; but the diagnosis is usually effected by observing that in aneurism the paroxysms of dyspnoea often come on in the day as well as at night, and are greatly increased by change of position, as by placing the patient either upright or recumbent, the tumour thus shifting its point of pressure. It is not, as Dr. Beilingham has pointed out, influenced by atmospheric changes, and is generally associated with laryngeal stridor. When such symptoms as these are associated with pain and dysphagia, they point very strongly, even in the absence of auscultatory signs, to the presence of an aneurismal tumour.

Aneurisms situated within the concavity of the aortic arch are those which, either directly by their pressure on the air-tubes or the pulmonary veins, or indirectly by the influence they exercise on the recurrent laryngeal nerve, are chiefly associated with dyspnoea.

3. *Dysphagia* is a symptom of sufficiently frequent occurrence in aortic aneurisms, Dr. Eaton having determined its existence in nine out of twelve cases. It seldom occurs, however, in the earlier stages of the disease, or when the aneurism is small, and hence is of much less diagnostic value than dyspnoea. When, however, it is associated with that symptom, the combination becomes important; as the co-existence of the two conditions clearly points to the compression of the œsophagus and the air-tubes by a tumour, which other diagnostic signs may prove to be aneurismal.

It is of importance to bear in mind that in some aneurisms, especially of the descending thoracic aorta, dysphagia may be one of the most marked signs. In such cases as these, stricture of the œsophagus has erroneously been supposed to exist, and the patient has even been treated by the introduction of bougies on this supposition,—an error of practice that has terminated fatally by the perforation of the aneurismal sac, where it projected against the œsophagus, by the point of the instrument.

The difficulty in deglutition in cases of compression of the œsophagus by aortic aneurism, is almost invariably referred to the episternal notch. The dysphagia is commonly associated with pain, or with the sensation of a cord drawn tightly around the body.

4. *Edema*, with more or less lividity of the upper extremities and head and neck, occasionally but rarely occurs. It is generally most marked on the left side, and arises from the compression of the superior vena cava or the innominate veins by aneurisms springing from the fore or upper part of the arch.

Pulsation and Tumour, in intrathoracic aortic aneurism, so far as they

are observable externally, are always absent in the early stages of the disease, and very frequently continue so throughout the progress of the affection; indeed, in aneurisms springing from the intrapericardial aorta or the concavity of the arch, death usually takes place, either by rupture into one of the serous cavities or the air-tube, or by the exhaustion induced by dyspnoea, long before the aneurism has attained a sufficient size to be cognisable externally. There are, however, three portions of the thoracic aorta which, when affected by aneurism, yield external evidence by the existence of pulsation or tumour of the true nature of the disease. These are—1, the anterior aspect of the ascending aorta; 2, the summit of the arch; and 3, the posterior aspect of the descending aorta.

1. When the aneurism is situated in the *anterior aspect of the ascending aorta and commencement of the arch*, pulsation may be detected by pressure between the intercostal spaces on the right side of the sternum, and a thrill, as well as distinct impulse, may often be felt over that side of the chest, before any external tumour becomes visible; thus simulating the beat of the heart, in addition and opposite to the seat of the true cardiac impulse. As the aneurism increases in magnitude, an external tumour appears, the wall of the chest becoming absorbed and perforated opposite the point of greatest impulse.

2. When an aneurism springs from the *summit of the arch*, a pulsating tumour appears at the root of the neck, behind or even above the margin of the sternum, most commonly towards the right side, and occasionally rises so high out of the thorax, and is so distinctly felt in the neck, as to run the risk of being confounded with aneurism of the brachio-cephalic or carotid arteries (Fig 207, p. 628). This error may be avoided by the impossibility of tracing with the finger the lower boundary of the tumour, and the existence of distinct dullness on percussion, possibly of impulse or of auscultatory evidence of aneurism, below the level of the upper margin of the sternum or clavicle.

3. When aneurism springs from the *posterior wall of the descending aorta*, a pulsating tumour may gradually develop itself to one side of the spine or under the scapula, commonly on the left side; and it may attain an excessive development, fully as large as the head, before the patient is destroyed by the rupture of the tumour externally.

TREATMENT.—The treatment of intrathoracic aneurism must be conducted on those principles that have been laid down at pp. 593—595.

ANEURISM OF THE INNOMINATE ARTERY.

Aneurisms of this artery may be either of the tubular or the sacculated kind, and usually give rise to a train of serious and dangerous symptoms, from their pressure upon important parts in their neighbourhood. Indeed, a glance at the relations of this artery will show the important effects that must be produced by the pressure of a tumour springing from it. Before it lie the left innominate vein and the superficial cardiac nerve; to its left is found the trachea, and more posteriorly the oesophagus; on its right are the innominate vein of that side, and the summit of the costal pleura; externally and posteriorly it is in relation with the pneumogastric, and more posteriorly and internally it lies before the right recurrent laryngeal nerve.

SYMPTOMS.—The general symptoms of an aneurism of this artery are the existence of a pulsating tumour of a globular shape behind the right sterno-clavicular articulation, attended with pain, and perhaps oedema of the right side of the face and arm, with some difficulty in respiration, laryngeal cough, and dysphagia. The tumour is usually soft and compressible, filling up

more or less completely the hollow about the sternum, and even rising as high in the neck as the lower margin of the cricoid cartilage; it pushes forwards, first the sternal, and afterwards the clavicular portion of the sterno-mastoid muscle, and has occasionally been seen to extend into the posterior inferior triangle of the neck; and, in deed, is generally more distinctly defined towards its brachial aspect. In some cases it is limited into the neck, but the sternum, clavicle, and costal cartilage of the first rib are found to be considerably pushed forwards beyond their natural position. In the space around the right sterno-clavicular articulation, and above the upper part of the sternum, there will be dulness on percussion. In very many instances there is no bruit, but merely a strong impulse with the heart's sounds, as distinct or even more so than in the cardiac region, and in other cases there is every variety of bruit.

Pressure-Effects.—The most important symptoms are occasioned perhaps by the pressure-effects of the tumour upon the neighbouring parts, affecting the pulse, the venous circulation, the nerves, respiration, and deglutition.

The *pulse* is usually influenced, being much smaller and feebler in the radial artery of the affected than of the sound side, and in some instances being completely arrested; owing, doubtless, to the occlusion of the sub-clavian. The pulsation in the right carotid and its branches is also frequently much less powerful than in the opposite vessel. These signs commonly occur before any external tumour is seen or can be felt, and hence constitute an important element in the early diagnosis of the disease.

Enlargement of the superficial veins of the neck and right upper extremity is of frequent occurrence, the external jugular being the vessel that is usually first dilated; at a more advanced period the superficial subcutaneous veins of the upper part of the right side of the chest often become tortuous, and form a dense plexus in this situation, while many anastomose with the cephalic and thoracic veins above, and the superficial epigastric below. As the pressure increases, oedema commences in the right eyelids and face, and may speedily extend to the whole of the head, face, and arm, which become hard and brawny in consequence of serous infiltration. In one case I have seen the left arm become suddenly cedematous, the left axillary vein being pressed upon. In these cases the eyes become staring and prominent, and the lips, nose, and features livid and turgid with blood, as well as cedematous, so as to greatly alter the expression of the countenance.

Pain of a dull aching character is experienced in the situation of the tumour, from the compression of the neighbouring structures. But, early in the disease, and among some of the first symptoms, the patient often experiences sharp shooting pains, apparently of a rheumatic or neuralgic character, in the arm and the side of the head and face, arising from pressure upon, and irritation of, the cervical and brachial plexuses of nerves. Taking up course of the ascending and descending filaments of the cervical plexus, the pain shoots up the side of the head and neck, over the shoulder and upper part of the chest; or, from pressure upon the brachial plexus, it radiates down the hand and arm, being usually especially severe about the elbow and fingers. The muscular power of the right arm also commonly becomes impaired.

Dyspnoea is of very common occurrence, and of very varying degrees of intensity, from slight difficulty in breathing up to fatal asphyxia. It may proceed either from irritation of the larynx, in consequence of compression of the recurrent nerve; or from pressure on the trachea or on the right bronchus. When it depends on laryngeal irritation, the voice is hoarse, husky, or whispering; and there is a dry, croupy, and paroxysmal cough, usually accompanied by expectoration of frothy serous mucus. In these cases, the

death the recurrent nerve will be found to be stretched out and greatly elongated by the pressure of the tumour (Fig. 203). Compression of the trachea, which becomes flattened and curved over to the left side by the protrusion of the tumour, is a common cause of dyspnoea, and is not unfrequently associated with the laryngeal irritation. More rarely by far, the right bronchus is compressed by the extension of the tumour downwards.

Dysphagia is of sufficiently frequent occurrence, and varies from slight uneasiness in deglutition to an impossibility in swallowing anything except fluids. I have never seen it occur without having been preceded by dyspnoea; and, in every instance that has fallen under my observation, it has been associated with laryngeal irritation. This coincidence of these two symptoms is readily explained by the anatomy of the parts, the recurrent nerve, lying between the artery and oesophagus, must suffer compression before the mucous canal can be interfered with.

Prognosis.—The prognosis of brachio-cephalic aneurism is in the highest degree unfavourable, though the disease frequently does not run a rapid course. If it extend upwards and outwards, the tumour may acquire a very large size before any very important organ or part is implicated; but if it press backwards and inwards, it may prove fatal at an early period. I know of no case in which such an aneurism, if left to itself, has undergone spontaneous cure, and but few instances in which the rupture of the sac has taken place. The most frequent cause of death is asphyxia, from spasmodic closure of the larynx induced by irritation of the recurrent nerve; or from pressure on the trachea.

Treatment.—There are several instances on record in which a properly conducted course of constitutional treatment has cured a patient; thus a case of Mr. Luke's was permanently cured by small and repeated bleedings, conjoined with the administration of digitalis. In connection with such treatment, distal pressure might be employed, as in a case that derived benefit from this plan in Mr. Syme's hands.

In aneurism of the innominate, the vessel is so short and the sac so situated that it is impossible to attempt to apply a ligature on the cardiac side of the tumour. What resource, then, does surgery offer in these cases beyond the employment of constitutional and dietetic means? It may be answered to this, that if these measures fail in arresting the disease, our choice must be between two alternatives; leaving the patient to his fate, or having recourse to the application of the ligature on the distal side of the tumour. On looking on the innominate artery with reference to the distal operation, we are struck by two peculiarities in the vessel, which must necessarily modify to a considerable extent not only the seat of the operation, but the principle on which it is conducted. The first peculiarity to which I allude is the shortness of the trunk, which makes it impossible to apply the



Fig. 203.—Aneurism of the Innominate Artery compressing and stretching the Recurrent Laryngeal Nerve and pushing the Trachea to the Left Side. (Back view.)

ligature to the vessel itself, but renders it necessary to deligate one or both of its terminal branches. The other peculiarity is, that under no circumstances can these vessels be so ligatured as to arrest the whole of the blood sent into the artery; for, although the circulation through the carotid may be entirely stopped, yet it is impossible, from the seat and extent of the disease, to tie the subclavian at any point except beyond the scaleni; hence that blood which is destined for the supply of the branches of this vessel—the vertebrals, the thyroid axis, the internal mammary, and the first intercostal—must continue to be propelled into and through the sac. Three distinct modifications of the distal operation have been proposed and resorted to for the cure of aneurisms in this situation: 1. Ligature of the Subclavian alone; 2. Ligature of the Carotid alone; and 3. Ligature of both Vessels with an interval of greater or less extent.

1. *Ligature of the Subclavian only* (Fig. 204, p. 624) has been practised in three cases, the results of which are exhibited in the accompanying Table; two were fatal, and the partial success of the third may be fairly attributed in a great measure to the accident of the carotid having been occluded. The results of this practice have certainly not been sufficiently favourable to justify the surgeon in repeating an attempt of this kind, opposed as it is to the known principles on which the distal operation effects a cure. For supposing, as we may safely do, with Mr. Wardrop, that only one-third of the blood that is sent into the innominate finds its way through the extrascapular portion of the subclavian, the remainder being destined for its branches and the carotid in equal proportions, what fact can be adduced or principle laid down from which we can expect to obtain the cure of an aneurism in close proximity to the heart, by cutting off so small a proportion as one-third of the supply of the blood sent into it?

ANEURISMS OF INNOMINATA TREATED BY LIGATURE OF SUBCLAVIAN ONLY.

OPERATOR.	SEX	AGE	RESULT.	CAUSE OF DEATH	REMARKS.
1. DUPUYTREN.	m	40.	Died on ninth day.	Exhaustion, following cough, and secondary hemorrhage.	Subclavian ligatured immediately above clavicle, tumour diminished, but pulsations continued. Aneurism of subclavian, with dilatation of innominate and aorta.
2. LAUGIER.	m	57	Died a month after operation.	Asphyxia.	Vessel ligatured immediately above clavicle. Aneurism of brachio-cephalic; aorta was dilated, and right carotid obliterated by the pressure of the tumour.
3. WARDROP.	f.	45	Died two years after operation.	Exhaustion.	Subclavian ligatured beyond scaleni, the pulsations in size of tumour diminished and respiration became freer, on the ninth day pulsation reappeared in right carotid, in which it had previously been absent. (We may regret the absence of operation to this circumstance.)

2. *Ligature of the Carotid only* (Fig. 205, p. 624) has been practised in nine cases, as recorded in the annexed Table, and in one case only does the disease

ANEURISMS OF INNOMINATA TREATED BY LIGATURE OF CAROTID ONLY.

OPERATOR.	SEX.	AGE.	RESULT.	CAUSE OF DEATH.	REMARKS.
1. EVANS.	m.	30.	Recovered living in 1863—thirty four years after operation.		Tumour diminished for a few days after operation, but at end of seven days it had increased of the sac not m, followed by obliteration of arteries of right arm and the branches of the carotid. At the end of a year tumour still existed, with constant pulsation. Next year the sac suppurated, and discharged much pus.
2. MOTT.	m.	55.	Died seven months after operation.	Asphyxia.	After operation, radial pulse on affected side disappeared; and tumour in neck was much diminished. After death, no external appearance of tumour, internally it was as large as a double fist.
3. ASTON KEY.	f.	61.	Died a few hours after operation.	Narrowing of vertebral arteries; brain not receiving sufficient blood for its functions.	Aneurism of innominata and of arch of aorta found. The orifice of left carotid nearly occluded, and vertebrals smaller than natural.
4. FERGUSON.	m.	56.	Died on seventh day.	Pneumonia.	Tumour and pulsation decreased after operation. Tumour nearly filled with firm laminated coagulum; no plug in carotid.
5. MORRISON.	m.	42.	Recovered from operation died twenty months afterwards.	Suddenly; cause not stated.	Aneurism of innominata and carotid found. Arch of aorta diseased. Right carotid dilated into a sac as high as part ligatured, and plugged by dense fibrinous laminae.
6. CAMPBELL.	m.	48.	Died on nineteenth day.	Pneumonia.	Tumour began to disappear after the vessel was ligatured. After death, aneurism of innominata and transverse portion of arch, and dilatation of aorta as far as diaphragm.
7. HUTTON.	m.	47.	Died on sixty-sixth day.	Bronchitis, inflammation, suppuration, and ulceration of sac into trachea.	Tumour diminished after ligature. Size and pulsation less. After death, tumour contained purulent matter, and grumous blood, had opened into trachea. Right carotid and subclavian contained firm coagula.
8. DU WRIGHT (Montreal.)	m.	70.	Died on sixtieth day.	Hemiplegia.	Tumour solidified by laminated fibrine. Subclavian pervious, with canal through tumour leading to it.
9. BROADBENT.	m.	50.	Died on one hundred and sixtieth day.	Exhaustion from secondary hemorrhage.	No alteration produced in tumour by the ligature. Secondary hemorrhage recurred several times.

appear to have been materially benefited; and in that instance the good effects can scarcely be attributed to the operation, but must rather be looked upon as an effort of nature to effect a spontaneous cure, the sac becoming inflamed and suppurating, and the arteries of the arm and head on the side affected undergoing obliteration. Mr. Key's patient died in consequence of the left carotid becoming occluded, and the brain being deprived of its proper supply of blood.

3. In three cases both the Carotid and Subclavian Arteries have been tied

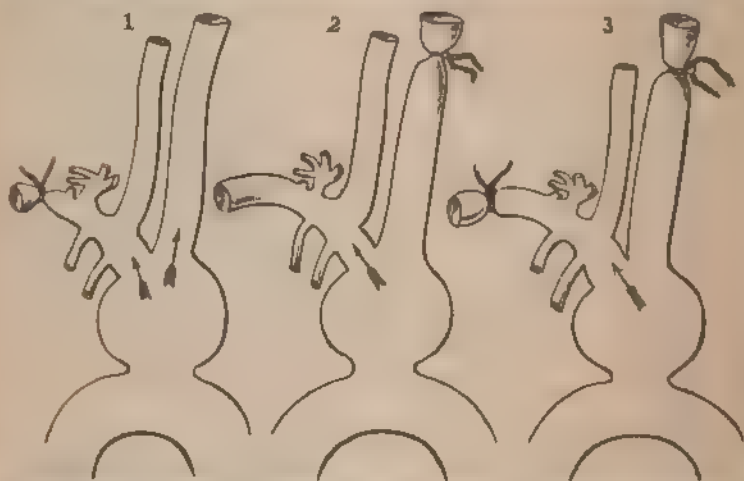


Fig. 204 — Brachio-cephalic Aneurism. Ligature of the Subclavian only.

Fig. 205 — Brachio-cephalic Aneurism. Ligature of the Carotid only.

Fig. 206 — Brachio-cephalic Aneurism. Ligature of the Subclavian and Carotid.

(Fig. 206). In the most favourable of these, that by Fearn, two years elapsed between the ligature of the carotid and that of the subclavian; the patient dying three months after the second operation: the sac was apparently filled with laminated conglulum, and appeared to be undergoing spontaneous cure. The

ANEURISMS OF INNOMINATA TREATED BY LIGATURE OF CAROTID AND SUBCLAVIAN.

OPERATOR.	SEX	AGE	CAROTID LIGATURED	SUBCLAVIAN LIGATURED	REMARKS.
1. FEARN.	f.	28.	Aug. 30th, 1836.	Aug. 2nd, 1838.	Died three weeks after second operation from pleurisy. Sac of aneurism of innominate filled with dense organised conglulum; except a channel of the size of artery for the passage of the blood.
2. WICKHAM	m.	55.	Sept. 25th, 1839.	Dec. 3rd, 1839.	Tumour diminished after ligature of carotid, and dyspnea ceased for a time, but symptoms returning, subclavian was tied. Relief of symptoms ensued, but tumour increased, and patient died two and a half months after first bursting of sac.
3. ROAST.	...	...	Carotid and subclavian simultaneously.		Death in six days. Occlusion of left carotid and right vertebral arteries—circulation of brain carried on by left vertebral merely.

third case is remarkable as being the only instance in which both the vessels were tied simultaneously, and from the patient having lived for six days after the occlusion of all the arteries supplying the brain except the left vertebral.

A *résumé* of the cases of aneurism of the innominate, in which the operation of ligaturing one or both arteries beyond the sac has been performed, having thus been given, the question arises whether these operations, or any of them, should retain a place in surgery. This question may be examined in two points of view: 1. As to the principle on which these operations are performed; and 2. As to their results in practice. For the success of the distal operation, it is requisite either that there be no branch given off from the sac, nor between it and the ligature; or that the current of blood through the sac be at least so far diminished as to admit of the deposition of laminated fibrine in sufficient quantity to fill it up, by a process similar to what happens in a case of aneurism treated by the Hunterian method. In order that this may be accomplished, it is certainly necessary that the greater portion of the blood passing through the sac be arrested; for if the current that is still kept up be too free, the tumour will continue to increase, as we have seen happen in cases of inguinal aneurism in which the femoral artery has been ligatured below the epigastric and the circumflex ilii, the current through which has been sufficient to feed the sac in such a way that a cure could not be accomplished. If, therefore, but one of the vessels leading from the brachio-cephalic, as the subclavian beyond the scapular, be tied, and but a third of the blood circulating through the main branch be arrested, are we justified in hoping that the circulation through the sac will be so influenced by the deprivation of this small quantity, that the remaining two-thirds of the blood, which will still pass through for the supply of the carotid and the branches of the subclavian, will gradually deposit those fibrinous laminae by which obliteration of the tumour is to be effected? Should we not rather expect that the larger current will be too powerful to allow the formation of these layers, and will continue to distend the sac in such a way as to prevent its contraction? Surely, if the comparatively small and feeble streams of blood, that pass through the epigastric and circumflex ilii, are sufficient to interfere with the cure of an inguinal aneurism after the distal ligature of the femoral, the strong current that sweeps through the carotid and the large branches springing from the subclavian, with the full force derived from close proximity to the heart, will be sufficient to prevent all lamination in an aneurism of the innominate. That the arrest of the circulation through one of these vessels only is not sufficient to influence materially the growth of the aneurism, is evident likewise from what is not unfrequently observed after death in cases of this kind—one or other of the vessels being found compressed and obliterated by the pressure of the sac, and yet no alteration in the tumour resulting. These cases, which are tolerably numerous, would of themselves have been sufficient to prove that something more than this amount of obstruction is required, in order to effect proper stratification of fibrine in the sac; and if we turn to the result of the eleven cases in which either the carotid or the subclavian has been ligatured, we shall find that in one case only, that operated on by Mr. Evans of Belper, has a cure been effected; and in this instance how was it accomplished? According to the principle on which it was attempted to be established! Certainly not; but, as will be seen by attention to the details of the case, and as has already been pointed out with much acuteness by Mr. Guthrie, by the accidental setting up in the artery of inflammation, which extended to the sac, and thus obliterated it.

In the only case (that of Mrs. Denmark) in which Mr. Wardrop tied the

subclavian for the cure of aneurism of the brachio-cephalic, there is some reason for doubt whether the arrest of the progress of the tumour was owing to the ligature of the subclavian artery, or whether it was not much influenced by the obstruction which existed in the carotid for nine days after the operation, during which time so abundant a deposit of laminated fibrine might have occurred as to arrest the progress of the disease for some length of time. In this case, also, Mr. Guthrie supposes it probable that the obliteration of the tumour might have led to its inflammation.

From a careful consideration of all the circumstances of the cases in which ligature of one vessel only has been employed for brachio-cephalic aneurism, we are, I think, fully justified in concluding that in seven of the cases the fatal result was accelerated, occurring as a consequence of the ligature of the vessel; in two the progress of the disease was in no way interfered with; in one it was arrested, the patient living for two years; and in one case only the disease was cured. The improvement in the last two cases was the result of accidental circumstances, which were unexpected, and unconnected in any way with the principles on which the operation was undertaken. These results would not, in my opinion, justify any surgeon in again undertaking either of these operations.

We have yet to consider the operation in which both arteries are ligatured. This double operation may either be performed with an interval between the application of the two ligatures, sufficient for the establishment of a collateral circulation; or the two vessels may be ligatured simultaneously. The former plan has been adopted in two cases; the latter in one only—not a sufficient number for any safe deduction. In one of the two cases in which an interval intervened between the two operations (that by Mr. Fearn), the tumour seems to have undergone a cure, being filled with dense laminated fibrine; but the patient died eventually of pleurisy. In the other case (by Mr. Wickham) no good results followed the operation, death occurring from bursting of the tumour. In the case in which both vessels were ligatured simultaneously, death occurred in consequence of the left carotid and right vertebral being accidentally occluded, and the cerebral circulation being then solely dependent on the left vertebral. As I have just said, these cases are not sufficiently numerous or free from modifying circumstances to enable us to draw any inference from them: we must therefore revert to the principle on which this operation should be undertaken. This will differ materially, according to whether the two arteries are ligatured simultaneously, or with a sufficient interval for the re-establishment of collateral circulation.

If an interval of two years, as in the first case, or even of two-and-a-half months, as in the second instance, be allowed to elapse between the ligature of the carotid and that of the subclavian, the operation reduces itself essentially to that of the ligature of a single artery, which, as has already been shown, is insufficient to induce those changes in the sac that are necessary for the accomplishment of a cure. If the patient survive the effect of the ligature of the carotid for a few weeks, sufficient time will be afforded for the proximal end of the subclavian, the vertebral artery, and the thyroid axis to have taken upon themselves a great increase of development, —the collateral circulation being carried on by them and not by the left carotid; so that by the time that the subclavian comes to be ligatured beyond the scaleni, the sac will still continue to be traversed by a current of blood for the supply of the branches of the subclavian, dilated to much beyond their normal size, in consequence of the task of supplying the right side of the neck, face, head, and brain being principally thrown upon them.

This current through the proximal end of the subclavian, increased as it will have been by the whole of that blood which is destined to supply the place of that which should pass by the carotid, will place the sac in nearly the same condition as if the subclavian also had been ligatured; and will consequently, for the reason that has already been given, be too powerful for us to expect a cure to take place in the course of its stream.

It now remains for us only to consider the simultaneous ligature of both vessels—an operation that has been but once performed, and then under such circumstances as to preclude our reasoning upon it, the patient having died from accidental occlusion of the left carotid and right vertebral arteries. In reasoning upon the simultaneous ligature of the two vessels, we must consider two points:—1. In what condition do we place the sac? 2. Is the danger of the patient much increased?

So far as the sac is concerned, it is impossible to place it in a better condition for the deposit of fibrinous matter; two-thirds of the blood flowing through it being arrested, and that only traversing it which is destined for the supply of the branches of the subclavian. It is by no means improbable that even this stream may yet be too large and forcible to allow the process of occlusion to take place, yet it is impossible still further to diminish it; and if the aneurism be sacculated, and project from one side of the artery, particularly to its internal or mesial aspect, it is by no means impossible that it may be sufficiently removed from the stream to allow of consolidation of its contents.

Would it add to the danger of the patient to ligature these two vessels simultaneously rather than separately? I think not. If the risk of a double operation is to be incurred, I cannot think that it would be positively increased by the two being performed at once, instead of at separate intervals; the whole of the vessels that serve to maintain the collateral circulation in the head and upper extremity—the vertebral, inferior thyroid, suprascapular and posterior scapular, and cervical—being left without interference.

ANEURISM OF THE CAROTID.

ANEURISMAL VARIX OF THE CAROTID ARTERY AND OF THE JUGULAR VEIN, as the result of punctures and stabs in the neck, has been met with in a sufficient number of instances to establish the signs and treatment of such a condition; and an instance is related by Mr. Mackmurdo, in which a communication was established between these vessels as the result of disease; but I am not acquainted with any case of *Varicose Aneurism* of these vessels having been recorded. The *Signs* of aneurismal varix in this situation present nothing peculiar; and the *Treatment* must be entirely of a hygienic character, no operative interference being likely to be attended by any but a fatal result. It is the more desirable not to interfere in these cases, as the disease does not appear to shorten life.

SPONTANEOUS ANEURISM OF THE CAROTID is not of very unfrequent occurrence: in Dr. Crisp's table of 551 aneurisms, 25 were of the carotid; and it ranks in order of frequency between those of the abdominal aorta and of the subclavian. It occurs more frequently in the female than any other external aneurism; thus, of the 25 cases alluded to, 12 were in women, owing probably to its seldom being the result of violence, but generally arising from disease of the coats of the vessel. This aneurism is also remarkable as occurring at earlier ages than most others: thus, Hodgson has seen it in a girl of ten; and Sykes, of Philadelphia, in one of eighteen. The right carotid is much more commonly affected than the left, and the upper portion of the vessel than the lower; indeed, the bifurcation is the

most common seat of aneurismal dilatation. The root of the right carotid not uncommonly is dilated; but I have never seen or heard of a case in which the left carotid, before emerging from the chest, has been affected.

SYMPTOMS.—A carotid aneurism in the early stage presents itself as a small, ovoid, smooth tumour, with distinct pulsation and bruit, and a well-circumscribed outline. It is commonly soft and compressible, diminishing in size on pressure, and expanding again with the usual aneurismal dilatation. As it increases in size, it becomes more solid, occasions shooting pains in the head and neck, and by its pressure on the pharynx, œsophagus, and larynx, produces difficulty in deglutition and respiration, when the salivary glands are much irritated. After a time, the cerebral circulation becomes interfered with, giving rise to giddiness, impaired vision in the corresponding eye, noises in the ear, and a tendency to stupor. These symptoms may each be owing to compression of the jugular, or to difficulty in the transmission of the blood through the tumour. The size that these aneurisms may attain varies greatly: usually they are confined to the space under the angle of the jaw, but not unfrequently they may occupy the greater part of the side of the neck. If they be allowed to increase without interference, death may happen, either by rupture externally, or into the pharynx or œsophagus; by asphyxia, from pressure on the larynx or recurrent nerve; or by starvation, from compression of the œsophagus.

DIAGNOSIS.—The diagnosis of carotid aneurism is without doubt more

difficult than that of any other form of internal aneurism: the best proof that it is, may, I think, be found in the fact that, out of 39 recorded cases in which the carotid artery has been ligatured for supposed aneurism of it or its branches, in 8 instances no such disease existed—solid cysts, or other tumours of the neck, having been mistaken for aneurism, and this by surgeons of great and acknowledged repute.

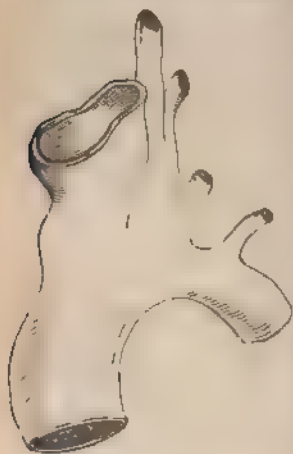
The diagnosis of aneurism of the lower part of the carotid from similar disease of other arteries at the root of the neck, as of the subclavian, vertebral, and brachio-cephalic, and the arch of the aorta, is surrounded by difficulties, which can only be cleared up by a careful stethoscopic examination of the part. In some aneurisms of the arch of the aorta, the sac rises up into the neck, so as closely to simulate a carotid aneurism, as in the annexed cut (Fig. 207); and this greatly

FIG. 207.—Aneurism of the Arch of the Aorta, simulating Carotid Aneurism.

increases the difficulty of the diagnosis. The principal affections of the neck, however, with which aneurism of the carotid may be confounded, are varix of the internal jugular, enlarged lymphatic glands, abscess, tumours, cysts in the neck, and pulsating bronchocele.

From varix the diagnosis may readily be made by attention to the following circumstances: that in varix the tumour is always soft; does not pulsate expansively; and diminishes in size during a deep inspiration, and on compressing the vein on its distal side.

Glandular tumours of the neck are often very difficult to distinguish from aneurism, more particularly when the artery passes through and is embraced by the tumour, so that the whole mass distinctly moves at each pulsation.



In these cases also there may be an apparent diminution in the size of the tumour on compression, by the artery within it being emptied, or by the growth receding into some of the cellular interspaces of the neck. But in the great majority of instances, attention to the globular, oval, and nodulated feel of glandular swellings, the possibility of raising them up and pushing them away from the vessel, which may best be done by feeling the carotid with the ends of the fingers of one hand, and then pressing upon the tumour with the other, will clear up the true nature of the case.

From *abscess of the neck* the diagnosis must be made on general principles: the coexistence of ill-defined hardness and of enlargement of the glands, of an inflamed state of the skin, the ready detection of fluctuation, and the absence of expansive pulsation in the tumour, will show that it is not aneurismal, however similar its other characters may be. It is also of importance to observe that an aneurism that fluctuates is always forcibly distended with strong pulsation, and can be materially diminished by pressure, neither of which circumstances can possibly occur in abscess. But if abscess may be mistaken for aneurism, the converse also holds good; and an aneurism may, unless care be taken, be mistaken for abscess—a far more fatal error. And there is one variety of false aneurism, that to which Mr. Liston has invited special attention, against which the surgeon must be carefully on his guard, on account of the many points of resemblance between it and aneurism: I mean the case in which an artery has given way into the sac of an abscess. In this case, fluctuation and pulsation will exist, although not perhaps of a distending kind. An important diagnostic mark will be, however, that the outline of an aneurism is distinctly defined and limited, while that of an abscess never is. Aneurism of the internal carotid has been found by Syme to simulate very closely *abscess of the tonsils*.

Tumours of various kinds—carcinomatous, fatty, and elastic—may occur in the neck, and cause some little embarrassment in the diagnosis from aneurism: thus Lisfranc, O'Reilly, and Kerr of Aberdeen have recorded cases in which the artery has been ligatured in such cases by mistake for aneurism. The diagnosis of such tumours as these must be effected on ordinary principles. I have in several instances met with a small, hard, distinctly circumscribed tumour, lying directly upon the carotid artery, and apparently connected with it and receiving pulsation from it, usually produced by a fit of coughing or laughing. This tumour, with the true nature of which I am unacquainted, remains stationary, and does not require any operative interference.

The thyroid body is not unfrequently the seat of pathological changes, that have been and may be mistaken for aneurism. These consist chiefly in a limited circumscribed enlargement of one of the lobes of the gland, which extends laterally over the common carotid, and receives pulsation from it. The most puzzling cases, however, and those in which mistakes may most easily be made, are instances of *pulsating bronchocele*, in which these tumours have an active and independent pulsation or thrill. In these instances, however, there are three points that will almost invariably enable the surgeon to effect the diagnosis. Thus the tumour, although principally confined to one lateral lobe, always affects the isthmus more or less. Then again, in bronchocele, that portion of the tumour is most firmly fixed which stretches towards the medial line; whilst in carotid aneurism the firmest attachment is under the sterno-mastoid muscle. The third point of difference is that, on desiring the patient to make an effort at deglutition, the enlarged thyroid body moves with the pharynx and trachea, and when it is

raised from the neighbourhood of the vessels, the pulsation in it ceases, whilst no effect is produced on an aneurism. *Cysts in the thyroid body* are of more common occurrence than pulsating bronchoceles, and sometimes equally difficult of diagnosis. Dupuytren has pointed out that, when these cysts are tapped, the pulsation often becomes stronger, and the fluid, which on first flowing is of a serous character, may at last become pure arterial blood, so that the surgeon may suspect that he has punctured an aneurismal tumour.

Aneurisms of the carotid are usually of slow growth, and may sometimes exist for a considerable number of years without giving rise to any special inconvenience: this is more particularly the case when they are seated at the bifurcation of the artery; when at the root, they are more likely to be attended by injurious pressure effects.

TREATMENT.—Since the time when Sir A. Cooper first ligatured the carotid, in 1805, the only means on which the surgeon relies for the cure of aneurism of this vessel is deligation of the artery at a distance from the sac. When the aneurism is so situated that a sufficient extent of healthy vessel exists between the sternum and the base of the tumour to admit of the application of a ligature, the Hunterian operation may be practised. If, however, the root or lower portion of the artery be so involved that there is no room to apply the ligature between the heart and the seat of the disease, the distal operation may be performed.

LIGATURE OF THE CAROTID.—When the surgeon can choose the seat at which to ligature the artery, he usually selects the part of the vessel which bisects the angle formed by the anterior edge of the sterno-mastoid with the omo-hyoid muscle. The artery is reached by making an incision, about three inches long, over its course upon the anterior edge of the sterno-mastoid, which is the directing line and a sure guide to the artery. After dividing the integument, the subcutaneous fascia, and cellular tissue, the sheath of the vessel is exposed. This must then be carefully opened, any branches of the descendens noni being avoided, and the ligature passed from without inwards, between the vein and artery. In performing this operation, subcutaneous vessels are occasionally wounded, which may bleed pretty freely; if so, they should be ligatured. When the sheath is opened, the jugular vein sometimes swells up considerably, so as to obscure the artery; but by being drawn aside with a retractor, or compressed by the assistant's finger, all difficulty from this source will cease. The pneumogastric is not seen, being drawn aside with the vein. If the aneurism have attained a very considerable size, extending low in the neck, and not leaving, perhaps, more than one inch of clear space above the clavicle for the surgeon to operate in, the difficulties are necessarily very greatly increased; and here the best plan will be to divide the tendon of the sterno-mastoid muscle, so as to give additional space. The external portions of the sterno-hyoid and sterno-thyroid muscles may likewise be cut across for the same purpose. The jugular vein in this situation lies considerably to the outside of the artery.

After ligature of the carotid artery, the blood is so freely conveyed to the distal end of the vessel, by the free communication subsisting between the arteries of opposite sides within the cranium, that a continuance and return of pulsation in the sac is of common occurrence. This condition, however, usually disappears after a time by the gradual consolidation of the tumour, and indeed may generally be looked upon as a favourable sign; being very seldom associated with those cerebral symptoms that, as will immediately be explained, commonly prove fatal after this operation. It is interesting to

observe that the collateral supply, after the ligature of the common carotid, is not afforded by any of the branches of the corresponding vessel of the opposite side, but by the subclavian artery of the same side. In a case related by Porter, in which the right carotid had been tied, the subclavian and vertebral arteries on the same side were enlarged to at least double their natural diameters, and the chief communications outside the skull took place between the superior and inferior thyroid arteries, which were enlarged; whilst inside the cranium the vertebral took the place of the internal carotid.

Suppuration of the sac is not of very uncommon occurrence after the ligature of the carotid for aneurism—sometimes even after so considerable an interval as eight months, as happened in a case related by Post. In the majority of these instances, the patient eventually does well; but death may result by the tumour pressing upon the pharynx and larynx, or by the occurrence of secondary hemorrhage, which may take place either from the part to which the ligature has been applied, or from the suppurated sac. In the first instance, it usually occurs about the period of the separation of the ligature; in the second, it may happen at a considerably later period, even after many weeks. Besides these, which may be looked upon as the ordinary accidents following the application of a ligature for aneurism, deligation of the carotid artery occasionally gives rise to serious and even fatal disturbance of the circulation within the cranium.

Effect on the Brain of Ligature of one or both Carotids.—Many experiments have been made by Mayer, Jobert, and others, upon the lower animals, with the view of determining the effect produced on the brain by the ligature of the carotid arteries. But the deductions from these are of no value whatever when applied to the human subject, for the simple reason (which appears to have been strangely overlooked), that in many of the lower animals on which the observations were made, as the dog and rabbit for instance, the common carotid arteries are of secondary importance so far as the cerebral circulation is concerned, being destined principally for the supply of the external parts of the head—the brain deriving its chief supply from the vertebrals, whilst in other animals, as the horse, the brain derives nearly the whole of its blood from the carotids, and but a very small quantity from the vertebrals. Hence, in one case the carotids may be ligatured without danger, whilst in the other their deligation is inevitably fatal. On turning to the result of observation on the human subject, we find, according to Norris, that of 140 instances in which the carotid artery was ligatured 32 were fatal, 18 of the deaths resulting from cerebral disease. The proportionate frequency of deaths from this condition, according to the cause that led to ligature, may be seen by reference to the following table:—

TABLE OF LIGATURE OF CAROTID FOLLOWED BY FATAL CEREBRAL DISEASE.

CAUSE OF LIGATURE.	NUMBER OF CASES.	DEATHS FROM CEREBRAL DISEASE.	DEATHS FROM OTHER CAUSES.
Aneurism	33	7	5
Wound	30	6	2
Erectile and other Tumours	42	1	5
Excision of Tumours	18	1	1
Cerebral Affections	6		
Distal Operation	15	1	1
	140	18	14

By this it will be seen that the most common cause of death after ligature of the carotid, is cerebral disease induced by the operation (as was, I believe, first pointed out by Dr. N. Chevers), and that this result appears to have followed the Hunterian more frequently than the distal operation. We should necessarily expect that, in those cases in which both vessels had been

CASES OF LIGATURE OF BOTH CAROTIDS.

OPERATOR.	AGE.	DISEASE.	DATES OF LIGATURE.	RESULTS.
1. PRESTON.	...	Epilepsy.	Right carotid tied Aug. 23; left carotid, Nov. 14.	Recovered.
2. PRESTON.	...	Epilepsy.	Tied at interval of month.	Recovered.
3. MACGILL.	...	Fungous tumour of both orbits.	Interval of a month.	Recovered.
4. MUSSEY.	20	Aneurism by anastomosis of scalp.	Left carotid, Sept. 20; right carotid, Oct. 2.	Recovered.
5. LANGENBECK.	...	Hemorrhage from superior thyroid.	Both at the same time.	Died next day.
6. MOLLER.	4½	Erectile tumour.	Sept. 13, and Jan. 28.	Recovered.
7. KÜHL.	53	Aneurism by anastomosis of scalp.	Left carotid first; right, forty-one days after.	Recovered, convulsions after each operation.
8. MOTT.	..	Disease of carotid.	Interval of fifteen minutes.	Coma, and death in a few hours.
9. ELLIS.	..	Secondary hemorrhage following gunshot.	Interval of four-and-a-half days.	Cured.
10. J. M. WARREN.	..	Erectile tumour of face.	Tied left, October 5; right, Nov. 7.	Cured.
11. VESPEAU.	29	Aneurism by anastomosis of both orbits.	Right carotid first, August, 1839, left, about three months afterwards.	Recovered.
12. BLACKMAN.	15	Fungus of nasal fossæ.	Right first; left, three weeks later.	Temporary loss of vision of left eye: recovery.
13. MUSSEY. (2nd case)	..	Erectile tumours.	Left first; right, one month after.	Temporary derangement of vision: recovery.
14. ROBERT.	...	Aneurism by anastomosis of forehead.	An interval of eight months.	Headache: temporary disturbance of vision: recovery.
15. ULLMANN.	20	Erectile tumour of orbit.	Left tied first; right one year afterwards.	Death on third day by hemorrhage.
16. BURNORF.	34	Aneurism by anastomosis and wound.	Left tied for the aneurism, five years afterwards the right, for a suicidal wound.	Disorganisation of right eye: recovery.
17. DUPUYTREN and R. BERT.	...	Aneurism by anastomosis of scalp.	Right carotid tied by Dupuytren in 1819, left by R. Bert for extension of disease, in 1867.	Delirium, hemiplegia of left side, and death.

ligatured, there would have been a greater tendency to cerebral disturbance than in those in which one only had been deligated. It would however appear, as is shown by the foregoing table (p. 632), that of seventeen instances in which the double operation has been performed, death happened but in two cases from this cause; while in another, in which convulsions took place, a fatal result did not occur, and three other cases were attended by mere temporary disturbance of vision.

After a careful examination of this subject, I think we are warranted in coming to the following conclusions. 1. Ligature of one carotid artery is followed by cerebral disturbance in about one fifth of the cases, more than one-half of which are fatal. 2. When both carotids are ligatured *simultaneously*, death has hitherto always resulted; as in the two cases in which Mott and Langenbeck ligatured these vessels, with an interval of but a few minutes between each operation. 3. When the two carotids are ligatured, *with an interval of some days or weeks*, the operation is not more frequently followed by cerebral disturbance than when only one is tied. 4. Pathological investigation has shown that, if the vessels be gradually and successively obliterated, the patient may live, although one carotid and one of the vertebral arteries have been occluded by disease and the other carotid ligatured, as in a case related by Rossi. 5. As in a case recorded by Dr. Davy, an individual may even live for a considerable time, though both carotids and both vertebrales be occluded—the cerebral circulation being maintained through the medium of the anastomoses of the intercostals and internal mammary arteries.

The frequency of the occurrence of cerebral disturbance, after cutting off the supply of blood sent to the brain through one or both carotid arteries, is well brought out in the statistics collected by Ehrmann. He finds that of 187 cases, in which one carotid was tied, in 42 instances cerebral disturbance of some kind ensued. If to these be added the cases in which both carotids were tied, and those in which the brachio-cephalic was ligatured, we get a total of 213 cases, of which 47 were attended by cerebral symptoms—or as nearly as possible 22 per cent.

The *Cerebral Symptoms* that arise from the ligature of one or both carotids may be such as depend upon a diminished supply of blood sent to the brain; consisting of twitchings, tremblings, or convulsive movements, syncope or giddiness, with paralysis, sometimes with complete homiplegia of the side opposite to that of the ligatured vessel, troubled vision, and deafness. In other cases, they appear to arise from increased pressure upon the brain—drowsiness, stupor, coma, and apoplexy supervening. To a third order of symptoms belong those that are of an inflammatory character, usually coming on a few hours after the operation.

The cause of these symptoms is certainly the disturbance of the cerebral circulation, induced by the ligature of the carotid. When a considerable portion of the supply of blood to the brain is suddenly cut off, two sets of symptoms may ensue—one *immediate*, the other *remote*. The immediate symptoms are those that generally result from functional disturbance of the brain, consequent upon too small a supply of arterial blood. They consist of syncope, trembling, twitches, giddiness, impairment of sight, and at last hemiplegia. After this condition has been maintained for a few days, the nutrition of the organ becomes materially affected, and softening of the cerebral substance takes place; giving rise to a new and more serious set of symptoms indicative of this pathological condition, such as convulsions, paralysis, and death. In other cases congestion may come on either by the interference with the return of blood through the jugular vein, or as a con-

sequence of that venous turgidity which we so commonly observe after the ligation of a main arterial trunk ; or perhaps coma may be induced by apoplectic effusion into a softened portion of the organ.

Inflammation of the brain may come on immediately after the application of the ligature, being apparently at once induced by the disturbance of the circulation. In other cases it occurs at a later period, as the result of alteration in the structure of the organ.

Effects on the Lungs.—Besides the brain, the lungs are not uncommonly secondarily affected after ligation of the carotid. To this condition special attention has been directed by Jobert and Professor Müller. The lungs appear to become greatly congested, and have a tendency to run into a low form of inflammation. The cause of this congestive condition of the lungs is extremely interesting. It cannot be owing to the simple obstruction of the passage of the blood through the carotid causing a disturbance in the balance of the circulation, and thus a tendency to internal congestion ; for if this were the cause, we ought to meet with it generally after ligation of the arteries of the first class. Nor can it be owing to any injury sustained by the eighth nerve during the deligation of the artery ; as in many of the instances in which it is stated to have occurred, there was no evidence of that nerve having been exposed or damaged, and every reason to believe the contrary, from the known skill of the operators. I am rather inclined to look upon the unusually frequent occurrence of pulmonary congestion after ligation of the carotid, as a secondary condition consequent upon a derangement in the functions of the brain and modulla oblongata, primarily induced by the disturbed state of the circulation through that organ : for we know that any cause which depresses the activity of the nervous centres tends to diminish proportionately the freedom of the respiratory movements, and thus, by interfering with the due performance of the act of respiration, disposes to congestion of the lungs, just as we observe to happen in injuries of the head, in apoplexy, and in the operation of the sedative poisons. It would appear from the detail of some of the recorded cases, as well as from Jobert's experiment, that blood-letting is of considerable service in the removal of this condition, and should consequently not be omitted.

LIGATION OF THE CAROTID ON THE DISTAL SIDE OF THE SAC.—Aneurism of the carotid artery, occurring low in the neck, does not admit of the application of a ligature on the cardiac side of the tumour. What, then, is to be done in such a case as this ? Should it be left to the remote chance of a spontaneous cure, or should it be subjected to surgical interference ? Spontaneous cure in carotid aneurism has never yet, I believe, been met with. The surgeon, therefore, must endeavour to treat the disease by ligation. Two plans of treatment are open to him—either to deligate the innominate artery, or to tie the carotid on the distal side of the tumour. The first alternative may fairly be set aside ; for not only are the cases in which it is possible to find room between the sternum and the sac extremely rare, but, even were such an instance to present itself, no surgeon would, I think, be justified in undertaking an operation which has never yet succeeded in the most skilful hands ; we are consequently reduced to the alternative of ligaturing the artery on the distal side of the sac. But although this operation is the only alternative that presents itself, yet its application in practice is attended by serious difficulties and perplexities ; for the surgeon must be able to satisfy himself that it is actually an aneurism of the root of the carotid with which he has to do, and that it is not the trunk of the innominate or the arch of the aorta that is affected. The difficulty in doing

this is far greater than would at first appear ; for, on examining the details of eight cases in which the distal operation has been performed for supposed carotid aneurism, three must be excluded ; as, after death, the tumour was found to arise from the aortic arch. In the annexed table will be found the

ANEURISMS OF ROOT OF CAROTID TREATED BY LIGATURE ON DISTAL SIDE.

OPERATOR.	SEX.	AGE.	RESULT.	CAUSE OF DEATH.	REMARKS.
1. WARDROP.	f.	63	Recovered.	... ..	Tumour diminished until fifth day ; then inflamed, suppurated, and burst. The patient recovered, and was alive three years after operation.
2. LAMBERT.	f	49	Successful so far as aneurism was concerned	Hemorrhage from upper part of artery.	Tumour diminished after operation, and became consolidated ; sac filled with firm coagulium, an lower part of artery closed, ulceration into artery, just above part ligatured ; vessel dilated where ligatured.
3. BUSH.	f.	36	Recovered.	...	Asphyxiation was imminent before operation ; tumour became rapidly diminished after ligature. Alive three years afterwards.
4. COLTON DE NOYON.	f.	63	Recovered.	... ..	Tumour and pulsation diminished. Alive and well three years afterwards.
5. LANE.	m.	35	Died 68th day.	Inflammation of lungs.	Tumour filled with layers of coagulium. Ulcerated opening communicating with apex of left lung.

result of five cases, in which the carotid artery has been tied for aneurism of its root on the distal side of the sac. I have excluded a sixth case, as there is reason to believe that in it the artery was not ligatured, but a portion of the sheath accidentally tied instead—an accident, by the way, which Sédillot has witnessed, and which Norris relates also to have occurred at the New York Hospital, and which I have known happen to a most excellent surgeon in the case of ligature of the femoral.

On analysing the five cases in which the trunk of the common carotid has been ligatured on the distal side of an aneurism of the root of that vessel, there are several points of interest that arrest our attention. Thus we find that in every case the tumour, immediately on the ligature being tightened, underwent a considerable diminution in its bulk, with corrugation of the integuments covering it, and considerable subsidence in the force of its pulsations. In one case—that of Bush—respiration, which before the operation had been attended with great difficulty, became easy ; and in another (that of Wardrop) inflammation of the sac, unattended however by any bad consequences, took place. It is not safe to deduce any general conclusion from so small a number of cases ; yet the result of these is so uniform, that I have no hesitation in stating it as my opinion that, whether we regard the principle on which this operation is founded, the amount of success which has hitherto attended it, the necessarily fatal result of these cases if left to themselves, or the absence of any other means that hold out

a reasonable hope of benefit, the surgeon is justified in resorting to the ligature of the trunk of the common carotid on the distal side of the sac, in cases of aneurism limited to the root of that vessel.

ANEURISM OF THE INTERNAL CAROTID.

The Internal Carotid Artery may be the subject of aneurism before or after it has passed through the carotid canal and entered the skull. The symptoms of these two classes of cases differ necessarily in almost every respect, as likewise do the termination and the susceptibility of the case to surgical interference.

EXTRACRANIAL ANEURISM.—When an aneurism affects the trunk of the internal carotid before its entrance into the skull, the symptoms presented by this disease do not materially differ from those of aneurism at the bifurcation, or of the upper part of the common carotid, except in one important respect, which was I believe first pointed out by Porter of Dublin—viz., tendency to the extension of the tumour inwards towards the pharynx, and to its protrusion into that cavity. The reason of this is obvious: when we consider the anatomical relations of the internal carotid artery, we at once see that its pharyngeal aspect is that which, if one may so term it, is the most superficial, and that between it and the surface the smallest amount of soft part intervenes—nothing lying between the vessel and the mucous membrane except the thin paper-like constrictor, some lax cellular tissue, and a few filaments of the superior laryngeal nerve; whilst externally there are interposed between it and the integument the layers of the cervical fascia, the margin of the sterno-mastoid, the digastric and three styloid muscles, and the styloid process.

When dilatation, therefore, of the vessel takes place, it has a necessary tendency to push forwards that part of its covering where it meets with least resistance; and this being to the pharyngeal side, more or less prominence will consequently be found in this cavity. In a case that occurred to Mr. Syme, this was especially well marked, the aneurism of the internal carotid simulating closely an abscess of the tonsil. In two cases related by Porter in the seventeenth volume of the *Dublin Journal of Medical Science*, this was one of the most marked features: the "appearance of the tumour (as seen by the mouth) were most alarming; the pulsation could be distinctly seen, and the blood almost felt under the mucous membrane; it seemed ready to give way and burst into the mouth every moment."

TREATMENT.—The treatment of these cases does not differ from that of aneurisms connected with the carotid arteries, and seated at the upper part of the neck; but we are not in possession of a sufficient number of facts to enable us to determine with any degree of precision what the result of surgical interference in them is likely to be. If we could give an opinion from the limited number of cases at present before the profession, we should feel disposed not to entertain a very favourable opinion of the result of the Hunterian operation, as applied to aneurism of the internal carotid outside the skull. This is doubtless owing to the situation of the aneurism against the mucous membrane of the mouth, being such that the surrounding tissues do not exercise a sufficient amount of pressure against the sac after the ligature of the vessel to allow the efficient deposition of lamellated coagulum, and consequent occlusion of the artery leading into it, which, in accordance with the principles that have been laid down in speaking of the Hunterian operation, are necessary to success.

INTRACRANIAL ANEURISM.

Aneurisms within the Skull may arise from any of the arteries that are met with in this situation, though some are much more liable than others to the occurrence of this disease. Of 62 cases noticed by Dr. Gull, the basilar artery was the seat of disease in 20 cases, and the middle cerebral in 15. In 8 of the remaining cases, the internal carotid was affected as it lay by the sella Turcica; and in 6 others the anterior cerebral artery was the seat of aneurism. The vertebral arteries and their branches were affected in 28 cases, and the carotids and their branches in 34.

The greater frequency of this disease in the basilar artery may probably be dependent on its large size, and the consequently greater impetus of the blood to it.

CAUSES.—The causes of intracranial aneurism are very obscure. It might be supposed that the comparatively small diameter of the arteries within the skull would render them little liable to the occurrence of spontaneous aneurism, were it not that the anatomical characters and physiological relations of these vessels predispose considerably to the occurrence of this affection; there being no other set of arteries in the body of the same size as these within the skull in which spontaneous aneurism so frequently occurs. This can only be accounted for by the thinness of their coats and the want of an external cellular sheath rendering them unable to support the increased pressure from within, to which they are occasionally subjected in consequence of the alteration in pressure of the cerebral circulation at different periods, the result of some variation in the relative quantities of the different fluids within the skull, or of determination of blood to the brain. This would more particularly be the case if their natural elasticity had already been impaired by the occurrence of atheromatous or other degeneration of their coats. As these changes are the natural consequences of advance in age, we shall find the tendency to the occurrence of this disease increase with advancing years. Thus, according to Dr. Gull, of 58 cases in which the patient's age is given, we find only 12 cases which occurred in persons under twenty-five, 5 of the patients being under twenty; of the remaining 46 cases, 13 occurred in persons under forty; of the remaining 33, 29 were met with between forty and sixty, and 4 in persons above sixty. Of the 58 cases, 35 were males, and 23 females.

The immediate exciting cause of the disease is most commonly involved in obscurity: sometimes it may be traced to a blow on the head, to a fall or concussion, or to excess in drinking; but more frequently the symptoms manifest themselves suddenly, without being in any way attributable to such external influences, and occur in vigorous and apparently healthy persons.

PATHOLOGY.—Intracranial aneurisms are almost always formed by the uniform dilatation of the whole of the calibre of the artery—the false or sacculated variety being rarely if ever met with: I am not acquainted with any instance of this. The coats of the arteries in this situation being very thin, and unprovided with any external cellular sheath that would support the impetus of the blood, rupture of the vessel would rather occur than partial dilatation, if one portion only of the circumference were diseased. Occasionally, though rarely, the dilatation is fusiform; when this does occur, it is probably confined to the basilar artery.

The disease would appear to be of slow growth, and the sac sometimes becomes filled with lamellated coagula so completely as to occlude the orifice of the artery from which it springs.

The size that aneurism in this situation attains before death results is sometimes considerable : thus, in a case of aneurism of the basilar artery, that occurred some years ago at the University College Hospital, the tumour was nearly as large as a walnut ; in another case, in the same hospital, it somewhat exceeded this size. Dr. R. W. Smith, in the *Dublin Journal of Medical Science*, vol. xxv., mentions a case of multilocular aneurism of the left posterior cerebral artery as large as a small apple ; and Serres, one as large as a hen's egg. On the other hand, they occasionally prove fatal by rupture before having reached more than a very small size—not larger than a pea or a nut.

It is seldom that more than one of the arteries of the brain suffer aneurismal dilatation. In the Museum of the College of Surgeons, however, are the preparations (Nos. 1687 and 1688) of an aneurismal dilatation of both internal carotid arteries, resembling "two bulbs about five-eighths of an inch in diameter, filling up the hollow on each side the sella Turcica, which were evidently dilatations of the carotid arteries ; and from their being filled with laminae of coagulated blood, there could be little doubt of their being aneurisms of these arteries. The one on the left side was the largest ; that on the right side communicated with the cavity of the artery, which was not the case with the other."

A case occurred in University College Hospital some years ago, under the care of Dr. Thomson, in which a somewhat similar condition existed. A man, forty nine years of age, had fallen on his head some months before admission into the hospital. Since then he had been garrulous, silly, and very irritable—becoming readily intoxicated. He suddenly became insensible and comatose, with vomiting and laborious breathing ; he could close both eyes, but the right pupil was dilated ; the left side was paralysed. He was treated for apoplexy, and became slightly better, but died in ten days from the first attack.

On examination, an aneurism a little larger than a hazel-nut was found on the trunk of the right carotid, where it gives off the middle cerebral artery, and another small one on the course of that artery. There was a globular aneurism on the corresponding artery of the opposite side ; the basilar artery was thickened, white, and opaque, as were also the other larger arteries of the brain ; there was softening of both anterior cerebral lobes, especially the right one.

The arteries of the brain are very commonly healthy in these cases. Out of four instances of intracranial aneurism that have fallen under my observation, the other vessels of the brain have been healthy in three cases, and atheromatous in but one. In one case I have seen aneurism within the skull associated with aneurism elsewhere—in the thoracic aorta.

PRESSURE-EFFECTS.—The pressure exercised by an aneurismal sac situated within the skull is always exclusively directed against the yielding cerebral substance, which is often extensively disorganised. The bones of the skull, however close their proximity to the sac may be, frequently escape, and seldom suffer much. This peculiarity in the effects of aneurism in this situation may be partly owing to the very dense and compact character of the inner layer of the skull, but is doubtless principally due to the very soft and yielding nature of the contents of the cavity. Absorption of the subjacent bone, however, sometimes takes place to a limited extent ; thus in one case (Moore's), the body of the sphenoid bone was indented and partially absorbed.

The parts comprised in each case will vary according to the situation of the tumour. But those that principally suffer are necessarily those seated

at the base of the brain, and forming the floor of the lateral ventricles. In Moore's case, one of the optic nerves was flattened by the pressure of the substance of the anterior lobe; the lamina perforata, the roots of the olfactory tract, the anterior part of the corpus striatum, and a considerable quantity of the neighbouring white matter of the anterior lobe, were removed. In a case by Lager, the portio dura of the right side was paralysed from this cause. In Dr. R. W. Smith's case, the floor of the third ventricle, the tuber cinereum, and the origins of the optic and olfactory nerves, suffered; the optic nerve of the opposite side was flattened and softened.

Besides the changes that take place in the cerebral substance as the result of pressure, important lesions may be met with as the effect of the interruption which the presence of the aneurism offers to the circulation in and nutrition of the cerebral hemispheres. Thus, in the case of aneurism of both internal carotids that has already been referred to as occurring at University College Hospital, there was white softening of both the anterior cerebral lobes; and this lesion was most marked on the side that corresponded to the largest aneurism, and where consequently, it may be supposed, the greatest amount of obstruction to the circulation existed.

SYMPTOMS.—The symptoms of aneurism within the skull are extremely equivocal; and, indeed, aneurism of large size may exist at the base of the brain without occasioning any symptoms whatever. An interesting instance of this occurred at University College Hospital in 1848. A man, thirty-seven years of age, died of pulmonary apoplexy and chronic pneumonia of the left lung, consequent upon the pressure of an aneurism of the commencement of the descending aorta on the pulmonary veins of that side. In examining the head after death, an aneurism of the basilar artery as large as a hazel-nut was met with, of which no suspicion had been entertained during life, there having been no head-symptoms whatever; the sac of the aneurism was very thin, and there was much atheromatous degeneration in the vertebral arteria.

The only symptoms that are of constant occurrence, when this disease goes on to a fatal termination, are those of hemiplegia and apoplexy. These may come on suddenly without any previous warning; or they may be preceded by a train of phenomena indicative of the existence of chronic disease within the cranial cavity.

The most constant of these phenomena is pain; which affects, however, great variety, both in extent and in character. It may be diffused, or may occupy a fixed point; it may be continuous or intermitting; it may be increased by movement, or accompanied by peculiar sensations, as of pulsation or of opening and shutting the top of the cranium.

The sight and hearing are often impaired. Dimness of sight, dilatation of one or both pupils, photophobia, diplopia, and loss of vision have been noticed in several of the cases recorded; ptosis has also been met with, from pressure on the third nerve by aneurism of the posterior communicating artery. Buzzing noises in the ears, and deafness, are also not uncommon symptoms; deafness, more particularly, appears to be a phenomenon of frequent occurrence.

The patient rarely loses the power of articulation and of deglutition; impairment of these functions, however, has been met with.

There may be paralysis of the side of the face, shaking palsy, or complete hemiplegia; or fits of an epileptic nature may occur. The mental condition may undergo changes indicative of chronic disease of the brain. There may be depression of spirits, listlessness, or, as was noticed in the case above

related, the temper may become irritable, and the patient be garrulous or silly. Insanity has been noticed in one case. As is always the case in cerebral affections, the gastric functions are often impaired.

But very frequently no premonitory symptoms manifest themselves; the patient being suddenly seized, when apparently in good health, with apoplexy, which terminates rapidly in death.

In some cases the presence of aneurism has been detected by a loud rough or "whizzing" noise being heard on the application of a stethoscope over one side of the head, and, perhaps, being audible to the patient. This sign, however, exists in but few cases; but when it does occur, it is unquestionably the most pathognomonic of all. I am not aware that it has been met with in any form of cerebral disease except intracranial aneurism.

Thus it will be seen by a reference to this list of symptoms that, with the exception of the whizzing noise, no special signs are afforded by aneurisms within the skull, which will enable us to distinguish between the symptoms occasioned by their presence and those of other tumours of the brain, and of organic cerebral disease.

CAUSES OF DEATH.—The fatal termination may occur from one of four causes.

1. The tumour may exercise such pressure upon the whole cerebral mass as to occasion death. This mode of termination is rare. I am acquainted with one case of this description, which is reported by Dr. Ruschenberger. The symptoms in this case were very remarkable, consisting of complete hemiplegia of the left side, with involuntary antero-posterior vibration of the head and body, and paralysis agitans of the right leg. The patient slept heavily, with loud anoring; he ate voraciously, but occasionally had considerable difficulty in deglutition and articulation; his intellect was clear, but very slow. After death, an aneurism of the basilar artery as large as a pigeon's egg, and containing an irregular very hard dry clot of blood, was found pressing on the pons Varolii. The sac had given way at one point, extravasation taking place into the substance of the pons, which was softened, and of a bluish colour.

2. The most frequent mode in which death takes place in these cases is by the sudden rupture of the sac and the extravasation of its contents into the cavity of the arachnoid and the meshes of the pia mater at the base of the brain, or into the lateral ventricles—either from the aneurism projecting into them and there giving way, or rupturing into these cavities by breaking down the intervening cerebral substance. When this mode of termination occurs, there are occasionally no warning nor premonitory symptoms of any impending danger; the patient being, apparently in good health, struck down by an attack of apoplexy which is speedily fatal. More frequently a series of those symptoms, that have already been mentioned as attending many cases of this disease, precede the fatal event for a longer or shorter time. When rupture of the sac and extravasation of blood takes place, death is inevitable; at least I am not acquainted with any case in which the appearance found after death converted me to the belief that the patient had even temporarily recovered from this condition.

Death from rupture of the sac appears to be most frequent in younger subjects. In the latter periods of life, aneurism is commonly associated with atheromatous disease of the vessels generally, which may cause death by softening and effusion of blood. According to Dr. Guil, of 20 cases occurring in persons under thirty-five years of age, 16 (or 80 per cent.) were fatal from rupture of the sac; while in 37 cases over thirty-five, death occurred from this cause in only 14, or 38 per cent.

3. Death may result from another cause than the pressure of the aneurismal sac or its rupture and the extravasation of its contents—viz., from softening or disorganisation of the substance of the brain to a greater or less extent, in consequence of the obstruction offered to the passage of the blood through the aneurismal vessel. In the case of aneurism of both carotids, already mentioned as having occurred at University College Hospital, this was the case; both anterior cerebral lobes were affected with white softening, and this condition was especially observable on that side on which the aneurism was largest.

4. Lastly, death may be produced by the mere irritation occasioned by the pressure of one or more aneurismal tumours within the cranium. Of this an interesting example is afforded by the history of a case of aneurism of both external carotids, contained in the Museum of the College of Surgeons, and related by Sir G. Blane in the *Transactions of the Society for the Improvement of Medical and Chirurgical Knowledge*, vol. ii. p. 192. In this case the patient, a lady aged 69, had suffered for four years from attacks of giddiness, headache, and imperfect vision; about sixteen months before her death she became insane, recovered, and then relapsed twice in the same state. After having regained her senses for some months, she became affected with giddiness, redness of the eyes, and violent maniacal delirium, which continuing for some weeks caused her death.

After death the following appearances were found. "Upon examining the body, there was no appearance in the brain itself that could in any way account for the symptoms. There was, indeed, a greater quantity of fluid than common in the ventricles, and the surface of it was moister than it is usually found in a sound state; but in all other cases which have occurred to me of organic affections of the brain proving fatal, except those which are sudden, such as apoplexy, there has been a preternatural quantity of fluid in its ventricles. There were also spicula of bone in the membrane forming the falx. The inner substance of the crura cerebri was of a brown colour, and more tender than natural. The optic nerves were smaller than natural, as if they had been wasted. The septum lucidum was more than usually dense.

"But the morbid appearance in this case, which was so singular, and to which the symptoms of complaint seem chiefly referable, was two bulbs, about five-eighths of an inch in diameter, filling up the hollow on each side of the Sella Turcica, which were evidently dilatations of the carotid arteries, and, from their being filled with laminae of coagulated blood, there could be no doubt of their being aneurisms of these arteries. The dissection was made by Mr. Hunter, assisted by Mr. Home, in the presence of Dr. Jenner and myself, and all concurred in the opinion that these tumours were aneurisms. The one on the left side was the largest. That on the right side communicated with the cavity of the artery, which was not the case with the other."

TREATMENT.—In the treatment of intracranial aneurism there is usually little to be done, the nature of the case not being sufficiently obvious in the majority of instances to justify active measures. Should, however, the loud rough whiz be distinctly audible over one side of the head, more especially about the base of the skull, or by application of the stethoscope to the mastoid process, and should symptoms of cerebral compression begin to manifest themselves, ligature of the carotid artery on the affected side may with propriety be practised. This has been successfully done in a most interesting and instructive case of intracranial aneurism by Mr. Coe of Bristol.

INTRAORBITAL ANEURISM.

Intraorbital Aneurisms were for a long time considered by surgeons to be of the nature of erectile tumours; but the error of this opinion has been pointed out by Mr. Busk, and more recently by Mr. Nunneley, who has conclusively shown that, except in those very rare cases in which a pulsating tumour of the orbit has been congenital, or has appeared shortly after birth, or has been associated with *naevoid* tissue developed in the eyelids, it must be looked upon as being a circumscribed aneurism. The vessel affected appears to be in some instances the ophthalmic artery itself; in other instances it would appear that the tumour is developed within the cranium, springing from the carotid artery, the ophthalmic being but secondarily affected.

CAUSES.—The causes of intraorbital aneurism are in some cases very obscure, in others it evidently and directly has originated from a blow upon the head. In the first class of cases, where the disease has been of spontaneous and not of traumatic origin, the patient has suddenly felt a crack or snap in the orbit, like the "crack of a whip," or the "snap of a gun," and the disease has then developed itself gradually. In the other or traumatic cases, the blow upon the head has usually been severe, attended in some instances with symptoms of fracture of the anterior part of the base of the skull. It is a remarkable circumstance that, in all the spontaneous cases on record, the disease occurred in women, and with one exception (a case of Mr. Nunneley's), appeared on the left side. The circumscribed intraorbital aneurism has been met with at all ages in adults, even in persons of advanced periods of life.

SYMPTOMS.—The first sensation experienced is, in spontaneous cases, that of a loud snap or crack in the orbit or head. This is followed by congestion of the conjunctiva, difficulty in opening the eyelids, a feeling of tension, and in some instances severe pain in and around the orbit. Loud whizzing bewildering noises are experienced in the head, and are much increased on stooping or lying down. In traumatic cases, a persistence of congestion of the conjunctiva, and the occurrence of noises in the head, are usually the first indications of the mischief that has occurred. In all cases, after a time, the eyeball becomes unduly prominent, and pulsation of a thrilling vibratory character can be felt in the orbit: on the application of the ear, a loud whizzing bruit is discernible, which extends widely over the side of the head. The eyeball itself falls into a state of chronic congestion; chemosis occurs, the cornea becomes opalescent, the aqueous humour turbid, and sight is impaired or lost. The bruit and pulsation are diminished or cease on compressing the carotid artery of the side affected.

TREATMENT.—The treatment of this formidable disease consists in the application of a ligature to the common carotid of the side affected. This operation has been highly successful. Out of 20 cases in which the operation has been performed, 14 have proved successful, there having been 3 deaths; 2 were only partially successful, and in 1 the pulsation continued unabated by the operation. Of 13 cases in which it has been done in England, 12 have been cured. In the case that proved fatal, death appeared to have resulted from accidental complications. In this instance—which is the only case that I am acquainted with where an opportunity has been afforded of making a dissection of the parts—it was found that the curve of the left carotid, just at the giving off of the ophthalmic, was diseased, and that the ophthalmic artery itself was dilated and atheromatous. In a very interesting case which I saw in M. Velpeau's wards in 1839, both orbits were

affected; and, as pressure on the right carotid arrested the pulsation and brunt in both, that artery was tied. But though the disease was cured in the left orbit by this operation, and temporarily arrested in the right, it reappeared in the latter situation, and was eventually cured here by the ligature of the left carotid.

ANEURISM OF THE SUBCLAVIAN ARTERY.

Aneurisms of the Subclavian occur in order of frequency between those of the carotid and of the brachio-cephalic arteries. They are most frequently met with on the right side, in the proportion of nearly three to one; and this would appear to be in a great measure dependent on their being occasioned by direct violence, or by repeated or prolonged exertion of the arm; thus they commonly occur from falls, blows upon the shoulder, or excessive fatigue of this extremity. From the fact of the aneurisms arising from external violence, we should expect to meet with them most frequently in males, and thus we do in a remarkable manner. Of thirty-two cases, I find only two occurring in females, and in both these instances the disease resulted from injury. The disease may be seated in any part of the vessel on the right side, though most commonly it is not dilated until after it has passed beyond the *scaleni*. On the left side, aneurism never occurs before the artery has emerged from the thorax; and then, as on the right, it most commonly happens in the third part of the course of the vessel.

SYMPTOMS.—An aneurism of the subclavian artery is characterised by a pulsating compressible tumour of an elongated or ovoid shape, situated at the base of the posterior inferior triangle of the neck, immediately above the clavicle. If it be small, it will disappear behind this bone on the shoulder being raised; as it increases in size, it fills up the whole of the space between the clavicle and the trapezius, often attaining a very considerable bulk. In consequence of the pressure which it exercises on the brachial plexus of nerves, there is pain, often attended by numbness, and extending down the arm and fingers, usually with some weakness of these parts. In some instances there is a spasmodic affection of the diaphragm, owing to irritation of the phrenic nerve. The external jugular vein is commonly distended and varicose, with oedema of the hand and arm, or even of the side of the body. The tumour does not increase rapidly in size, owing to its being tightly compressed by the surrounding parts; and, as the disease never extends inwards, it does not interfere with the trachea or oesophagus. In some cases it has been known to extend downwards and backwards, so as to implicate the pleura and the summit of the lung.

DIAGNOSIS.—The diagnosis of these aneurisms is usually easy, and presents no point of a special character.

RESULTS.—As subclavian aneurisms increase in size, they may become diffused, and burst either externally or into the pleural sac. In some instances a spontaneous cure has been observed.

TREATMENT.—The treatment of subclavian aneurism is in the highest degree unsatisfactory. The attempts at obtaining consolidation of the tumour by constitutional means, by *galvano-puncture*, or *compression*, have hitherto failed, except in some very rare instances. A case is reported by Yeatman of the cure of subclavian aneurism by *Valsalva's* plan in eighteen months; and another by Dr. Abellie, in which the tumour was consolidated by *galvano-puncture*. *M manipulation*, as recommended by Ferguson, has succeeded in the hands of Little, and undoubtedly deserves a trial in those cases, when we consider the extreme danger and almost universal want of success that attend other means of cure.

Ligature of the brachio-cephalic, and of the subclavian itself, before, between, and beyond the scaleni muscles, has been practised for the cure of this form of aneurism; it has likewise been proposed to apply the distal operation to the treatment of this disease, and to amputate at the shoulder-joint.

When an aneurism is situated on the right subclavian artery on the tracheal side of the scaleni, there is no way in which the flow of blood through it can be arrested, except by the ligature of the brachio-cephalic artery. When it is situated beyond the scaleni, or even between these muscles, the ligature of the vessel has been practised in the first part of its course before it reaches these muscles. For subclavian aneurisms on the left side, in these situations, no operation conducted on the Hunterian principle would be practicable.

Let us now proceed to examine the results that have attended these operative procedures.

LIGATURE OF THE BRACHIO-CEPHALIC.—The brachio-cephalic artery, as may be seen by the accompanying table, has been ligatured eleven times, and in every instance with a fatal result. In four other instances the operation has been commenced, but abandoned owing to unforeseen difficulties, and this by some of the most skilful operators that their respective countries can boast of.

Although, in reasoning on the propriety of performing an operation, it is not in general worth while to take into consideration the difficulties that a surgeon may encounter, provided the operation be at last practicable; yet, when we consider the fact of the ligature of the brachio-cephalic having been attempted, and in consequence of unforeseen and insurmountable difficulties left unconcluded in so large a proportion as one-fourth of the cases, and these in the hands of surgeons who were as well able as any to accomplish whatever was in the power of operative surgery to do, we may well hesitate upon the difficulties that beset the operation itself, before proceeding to the consideration of its results. The difficulties to which I allude do not consist merely in the position and anatomical relations of the vessel, but rather in the condition in which the artery and the adjacent structures may be found after the vessel is exposed. Thus, in Porter's case, the aneurism, which was a large one, occupied the whole of the inferior posterior triangle of the neck, being nearly six inches broad; as no pulsation was traceable in the vessels beyond the aneurism, it was useless to attempt ligature on the distal side. On exposing the brachio-cephalic, that vessel was found to be diseased, and it was not thought desirable to pass the ligature round it. In consequence of the exposure of the artery, however, the pulsation in the tumour gradually diminished, and at last ceased entirely, its bulk also becoming less.

In Key's case, in which it was impracticable to pass the ligature, it was found after death that the brachio-cephalic was diseased, being dilated immediately after its origin into an oblong tumour, which occupied the whole of the artery. It is remarkable that in this case, as in Porter's, inflammation seems to have taken place in the artery in consequence of the necessary handling to which it was subjected, and that the pulsation in the sac consequently diminished.

The difficulties of the operation are in themselves of serious magnitude; arising from the depth of the vessel, from its proximity to the centre of the circulation, and from the neighbourhood of large veins, which may become turgid, and a wound of which not only obscures the line of incision with venous blood, but induces a risk of the entrance of air into the circulation. But even when these have been surmounted, and the artery has been

CASES OF LIGATURE OF BRACHIO-CEPHALIC ARTERY.*

OPERATOR.	SEX.	AGE.	NATURE OF DISEASE.	RESULT.	REMARKS.
1. MOTT.	m.	57	Subclavian aneurism.	Died on 26th day.	Tied an inch below bifurcation. Ligature separated in fourteen days. Hemorrhage on twenty-fifth, stopped by pressure. Recurred on twenty-sixth.
2. GRAPPE.	..	..	Subclavian aneurism.	Died on 67th day.	Ligature separated in fourteen days. Died of hemorrhage.
3. HALL.	...	...	Subclavian aneurism.	Died on 5th day.	Artery was diseased and gave way. Bleeding arrested by plug: death from other cause.
4. DUPUY- TREN.	...	...	..	Died.	Case referred to as occurring in the practice of Dupuytren.
5. NORMAN.	..	...	...	Died.	..
6. BLAND.	m.	31	Subclavian aneurism.	Died on 18th day.	Hemorrhage came on on the 17th and 18th days. Ligature applied to upper portion of artery.
7. LILIAN.	..	..	Subclavian aneurism.	Died on 21st day.	Ligature separated on 17th day. Hemorrhage on 19th.
8. HUTIN.	m.	26	Hemorrhage from axilla after ligature of subclavian.	Died in 12 hours.	Punctured wound in axilla, for which subclavian was tied, secondary hemorrhage, and then brachio-cephalic tied.
9. ARENDT.	..	..	Subclavian aneurism.	Died on 8th day.	Inflammation of lung, pleura, and aneurismal sac.
10. COOPER (See Frem- onco).	m.	...	Subclavian and carotid aneurism.	Died on 9th day.	Upper end of sternum and inner end of clavicle removed. Dyspnea and retention of urine, pus in the right kidney.
11. COOPER.	m.	...	Subclavian and carotid aneurism.	Died on 34th day.	Bones removed as in previous case. Patient was apparently doing well, when secondary hemorrhage appeared. Immediate cause of death, hemorrhage, in consequence of removal of bandages by patient.

* N B.—The artery was cut down upon, but not actually ligatured, by Porter, Post, Aston Key, and Hoffman.

exposed, its coats may be found so diseased, or its calibre so increased, that it may be undesirable or impossible to pass a ligature round it. The failure in deligating the artery would, however, as we shall immediately see, appear to be less disastrous in its consequences than success in that attempt; for of the three cases that have just been referred to, in which this attempt was made and did not succeed, one was cured of the disease, the artery being obliterated by adhesive inflammation; and in another, Key's patient, an attempt to set up this action appears to have been made, the tumour becoming solid and ceasing to pulsate; whereas in every case in which the vessel was ligatured, a fatal result speedily ensued.

* These are all the cases of ligature of the brachio-cephalic artery the details of which I have been able to collect. This artery was also said to have been once ligatured by Kuhl and twice by Bland. In these cases I find in a short time, but, as I can find no historical record of them, I have omitted them in the above table. Garlin in his Report on Surgery (*Archiv für Klinische Chirurgie*, vol. vi. 1865) says, in speaking of Cooper's second case: "This is the fifteenth case of ligature of the innominate artery, and every one of them has proved fatal."

The results of the ligature of the vessel are then in the highest degree discouraging; for of the eleven cases in the table in which it has been done, not one recovered. In three more it is said it have been tried with speedily fatal results; and in four cases the operation, after being commenced, was abandoned. Death occurred from secondary hemorrhage in five cases; from inflammation of the lungs or pleura in one; from diseased kidney in one; and in three from causes that are not mentioned.

In one case, that of Hall, the artery was transfixed by the aneurism needle; hemorrhage occurred at the time, which was arrested by plugging, and did not recur, the patient dying from other causes. In three cases, those of Mott, Bland, and Lizars, the hemorrhage came on shortly after the separation of the ligature; but in Grafe's (the most successful) it did not occur for fifty-one days after this, the cicatrix in the artery having then probably given way under the influence of some imprudent movement on the part of the patient. In Cooper's second case, the patient appeared to be going on well for some weeks, when secondary hemorrhage appeared. Learning that nothing further could be done, the patient tore off the bandages when alone, and bled to death. With such results as these, there can, I think, be but one opinion as to the propriety of such an operation being again had recourse to. As its performance has hitherto in every instance entailed death, and, in all cases but one, a speedy death to the patient, it should without doubt be banished from surgical practice; and I can think of no circumstances that should induce a surgeon, in the face of the consequences that have hitherto invariably followed the application of a ligature to the brachio-cephalic artery for subclavian aneurism, again to have recourse to such a procedure.

LIGATURE OF THE SUBCLAVIAN.—If the aneurism be situated on the right subclavian artery, between or beyond the *scaleni*, that vessel has been *Ligatured on the Tracheal Side* of these muscles; on the left side this operation is not practicable, on account of the depth at which the artery is situated. When we consider the anatomical relations of that portion of the right subclavian which intervenes between the brachio-cephalic artery and the tracheal edge of the *scalenus anticus* muscle, we are at once struck with the great difficulties of this undertaking; and when we reflect on the position in which the ligature will be placed between the onward current of blood in the brachio-cephalic on the one side, and the regurgitant stream conveyed by the vertebral, the thyroid axis, the internal mammary and intercostal, into the subclavian, immediately beyond the seat of deligation on the other side, we can scarcely, in accordance with those principles on which the formation of a conglum within a ligatured vessel takes place, anticipate any but the most disastrous results.

In reference to the mere difficulties of the operation, Fergusson justly characterises it as the most serious in surgery: the proximity of the common carotid artery on one side, the internal jugular vein on the other, the vena innominata below, the par vagum and numerous small venous trunks in front, the recurrent laryngeal nerve and pleura behind, constitute relations of sufficient importance to justify Fergusson's opinion. But supposing these difficulties overcome, and the ligature applied, this must be situated, as has just been stated, in such a position, with a strong current of blood flowing upon each side of it, as to render the formation of an internal conglum, and consequently occlusion of the artery, impossible, and thus to lead inevitably to the occurrence of fatal hemorrhage on the separation of the ligature. Besides the danger of secondary hemorrhage from these causes, there would be the additional risk of the coats of the artery being diseased,

as we commonly find them in a more or less morbid state in the immediate vicinity of aneurisms; and, it being rendered insusceptible of healthy inflammation, ulceration and sloughing would take place along the track of the ligature, causing the probability of a recurrence of hemorrhage. Thus, in Coles's case it was found, on exposing the subclavian artery, that the aneurism had extended in such a way towards the carotid, that it was doubtful whether any part of the affected vessel continued sound. On exposing it fully, it was found that only a space of the vessel three lines in length remained free between the sac and the bifurcation of the brachio-cephalic, and it was in this narrow space that the ligature was applied.

The subclavian has been ligatured on the tracheal side of the scaleni muscles in eight cases, all of which proved fatal; seven from hemorrhage, and one from inflammation of the pericardium and pleura.

The cases are as follow.

SURGEON.	SEX.	AGE.	DATE OF DEATH.	CAUSE OF DEATH.
COLES.	m.	33	4th day.	Hemorrhage.
MOTT.	f.	21	18th day.	Hemorrhage.
HAYDEN.	f.	57	12th day.	Hemorrhage.
O'REILLY.	m.	39	13th day.	Hemorrhage.
PARTRIDGE.	m.	38	4th day.	Pericarditis and pleurisy.
LISTON.*	m.	..	13th day.	Hemorrhage.
LISTON.†	m.	...	36th day.	Hemorrhage.
COVILLIER‡	m.	..	10th day.	Hemorrhage.

Thus it will be seen that, while this operation is bad in principle, it is most unfortunate in practice. This table is, to my mind, conclusive as to the merits of the operation, the patient having in every case but one been carried off by secondary hemorrhage from the distal side of the ligature, in consequence of the close proximity of numerous collateral branches (Fig. 208); and in the exceptional case the operation, although performed with the utmost delicacy and skill, proved fatal from pericarditis and pleurisy before the period at which secondary hemorrhage might have been expected. Liston, in one case, ligatured the root of the common carotid, as well as that of the subclavian, hoping in this way to diminish the risk of the supervention of this fatal hemorrhage, by arresting the current of blood which, by sweeping into the carotid past the mouth of the subclavian, would necessarily wash away any coagulum that might be formed in this artery. But his expectations were not realised: hemorrhage took place as usual, and from that portion of the artery which lay on the distal side of the ligature, the blood having been carried into this part of the vessel in a retrograde course, through the connection existing between the vessels arising from it at



Fig. 208.—Ligature of the Subclavian in the First Part of its Course (Liston)

* In this case the carotid was also tied, but the hemorrhage came from the subclavian (Fig. 209).

† Fig. 208

‡ Carotid also tied.

this point, and those on the opposite side of the head and neck, as illustrated by the annexed cut (Fig. 209), taken from the preparation of the



Fig. 209.—Ligature of the Subclavian and Carotid for Subclavian Aneurism. (Liston)

case in the University College Museum. Indeed, this is the great danger to be apprehended after ligature of the subclavian artery on the tracheal side of the scaleni, depending as it does on the anatomical relations and connections of the vessel, which no skill on the part of the operator can in any way lessen, and which, in my opinion, ought certainly to cause this operation to be banished from surgical practice.

When an aneurism is situated on the subclavian artery, in the posterior inferior triangle of the neck, it is necessarily impossible to ligature that vessel beyond the scaleni, as there would not be sufficient

room for the exposure of the artery, which, even if laid bare, would in all probability be found in too diseased a condition to bear the application of a ligature.

Thus it will be seen that, in every case in which an aneurism of the subclavian artery has been subjected to operation, whether by ligature of the brachio-cephalic or of the subclavian itself internally to the scaleni, the result has been a fatal one. As this unfortunate termination to every case that has yet been submitted to surgical interference is in no way to be attributed to want of skill on the part of the operators—who have been, without exception, men greatly distinguished for the possession of this very quality—but is solely dependent on certain anatomical peculiarities in the arrangement of these vessels, by which their successful ligature has been rendered impossible, a repetition of these attempts, which may hasten the patients' death, can scarcely be considered justifiable. What then are we to do? Are we to leave patients labouring under aneurism of the subclavian artery to inevitable death, without making an effort to save them? Or does surgery offer other modes of treatment besides those just mentioned, by which we may hope to arrive at more successful results?

Without mentioning manipulation or galvano-puncture, which are certainly deserving of further trials in combination with appropriate constitutional treatment, three modes of treatment present themselves:—

1. Compression on the Artery where it passes over the First Rib, and consequently on the Distal Side of the Tumour.

2. Ligature of it on the Distal Side, above or below the Clavicle.

3. Amputation at the Shoulder-joint, and Distal Ligature of the Artery.

1. *Compression of the Artery on the Distal Side* of the sac could only be effected where it crosses the first rib, and consequently would only be applicable to aneurisms of the first part of this vessel. This plan has never been tried: partly, perhaps, on account of the difficulty in applying pressure in this situation, and partly, probably, on account of the want of success that has attended procedures of this kind when applied to vessels in other situations.

The difficulty in applying the compression might, I think, be overcome by the use of the instrument of which a representation is given by Bourgery.

and the efficiency of the compression would be materially increased by the employment of galvano-puncture at the same time, and in this way a coagulum might be formed in the sac. Although much ought not to be expected from this mode of treatment, yet I think it might with propriety be tried in cases of the kind that have been mentioned.

Dupuytren ligatured the axillary artery under the pectoral muscles for a case of subclavian aneurism, two arterial branches being divided in the incisions through the fat and cellular tissue; and the patient died on the ninth day. This is the only instance, to my knowledge, in which the distal operation has been attempted for the cure of this disease. It could not be expected to succeed; for between the ligature and the sac are the large and numerous alar, acromial, and thoracic branches of the axillary artery, which would continue to be fed by a current sent through the tumour, and thus preclude the possibility of its contents being sufficiently stationary for ultimate contraction and cure to result. Langier performed the distal operation in a supposed case of subclavian aneurism, which afterwards turned out to be one of the brachio-cephalic artery.

2. *Ligature of the Subclavian Artery in the Third Part of its Course*, on the distal side of the tumour, has been suggested, and may, perhaps, hold out some prospect of success in cases of aneurism situated between or internal to the scalem. In an aneurismal sac springing from the artery in this situation, the principal current of blood would, in all probability, be that which is destined for the supply of the upper extremity. Some of the branches arising from the artery before it has passed beyond the *scalemus anticus* would, doubtless, be more or less compressed, and thus obliterated, by the tumour; or they might be obstructed by an extension of the laminated fibrine over their orifices. If, therefore, the supply to the upper extremity could be cut off, there might be a possibility of those changes taking place within the sac which are necessary for the obliteration of its cavity. The principal obstacles to this desirable result would necessarily be the *transversales colli* and *humeri* arteries; which, being the two vessels that are more particularly destined to carry on the circulation in the upper extremity after the ligature of the subclavian, would necessarily, if not occluded, undergo dilatation, and thus continue to draw too large a current of blood through the sac for stratification of its contents to take place; and, if they were occluded, there would be danger of gangrene of the arm from insufficient vascular supply.

3. The above-mentioned difficulties are met by a plan of procedure, the suggestion of which has originated, I believe, with Mr. Fergusson, but which has not, to my knowledge, been had recourse to as yet. It is *Amputation of the Arm at the Shoulder-joint*, followed by *Distal Ligature of the Artery*—a desperate undertaking truly, but for a desperate disease, it must be remembered, and one that has never yet, under ordinary surgical treatment, been cured.

The artery might be ligatured before the amputation. "It is known," says Fergusson, "that amputation at the shoulder-joint is generally a very successful operation; so far as this wound is concerned, then, there might be little to apprehend, but the effect on the tumour is not so easily foretold. Ligature of the axillary artery on the face of the stump might here be reckoned like Brador's operation; yet there is a vast difference, for in the latter case the same amount of blood which previously passed towards the upper extremity, would still find its way down, and probably part of it would run through the sac; whereas, were the member removed, as the same quantity would no longer be required in this direction, the tumour might possibly be much more under the control of pressure. The

value of such a suggestion remains yet to be tested, however, and it would be futile to reason upon it at present. It might be a judicious venture first to tie the axillary or subclavian under the clavicle; and then, if it were found that the aneurism still increased, amputation might be performed, either immediately before or after the separation of the ligature."

Were a case of aneurism of the subclavian artery internal to the scaleni to present itself to me, the plan that I should adopt would be, first the employment of pressure on the vessel at the distal side of the tumour, if practicable; should this not succeed, I would, if the disease were situated between or internal to the scaleni, ligature the artery in the third part of its course; and, did that not succeed in checking the increase of the aneurism, I would perform amputation at the shoulder-joint, as recommended by Mr. Fergusson. Should the aneurism occupy the artery after it has passed the scaleni, I would not attempt the ligature of the artery below the clavicle; as it is an operation the result of which is not very satisfactory, and would not prevent a large current through the sac for the supply of the collateral circulation of the arm; but I would at once have recourse to amputation at the shoulder, and then ligature the vessel as near as possible to the sac. It is true that, even in this case, the ligature would be below the branches that are given off under the pectoral muscles; but, as the arm would be removed, they could not undergo any increase of activity for the supply of the collateral circulation of the upper extremity.

ANEURISM OF THE AXILLARY ARTERY.

This artery, though less commonly the seat of aneurism than other large vessels, such as those of the ham, the groin, and the neck, yet is sufficiently frequently diseased. This is due partly to its situation, its proximity to the shoulder-joint causing it to be subjected to the very varied, extensive, and often forcible movements, of which that articulation is the seat; and partly to the artery being deficient in that support which would be afforded it by an investing sheath, such as is commonly met with in arteries of corresponding magnitude. Amongst the most frequent causes of axillary aneurism, may be mentioned falls upon the shoulder or upon the outstretched hands, and in many cases the efforts made at reducing old standing dislocations, instances of which are recorded by Pelletan, Flaubert, Warren, and Gibson; the head of the bone in these cases having probably contracted adhesions to the artery, in consequence of which the vessel was torn during the efforts at reduction. Axillary, like subclavian aneurism, occurs more commonly on the right than on the left side, and is met with in especial frequency amongst men: of 37 cases, only 3 occurred in women.

SYMPTOMS.—In axillary aneurism, there are three sets of symptoms, attention to which will usually enable the surgeon to recognise the disease; these are, the existence of a tumour in the axilla, the pain that it occasions, and the affections that it gives rise to in the limb.

The precise situation at which an aneurism of the axillary artery presents externally, will depend upon whether it springs from that portion of the vessel that lies above, beneath, or below the lesser pectoral muscle. If from above, it will appear as a tumour seated immediately below the clavicle and occupying the triangular space between the upper margin of the lesser pectoral and that bone; if it be lower down, it will raise the anterior fold of the axilla, being prevented from extending much out of this space by the dense fascia that stretches across from one side to the other. The tumour, which is at first soft and compressible, has a whizzing bruit; and its pulsations, which are expansile, may be arrested by pressure upon the subclavian artery.

where it passes over the first rib. It usually increases with great rapidity, owing to the little resistance opposed by the loose cellular tissue in this situation, and most commonly extends downwards and forwards, causing the hollow of the axilla to disappear. In some rare instances, however, the tumour has been known to take a direction upwards under the lesser pectoral, and into the cellular interval above that muscle, or even underneath the clavicle into the acromial angle between it and the trapezius. Such a course for the aneurism to take is fortunately rare, as it presents a serious inconvenience in the ligature of the subclavian; and there is more than one instance on record, in which the sac has been punctured in the attempt to pass the needle round this vessel. When the aneurism is seated high up, it not unfrequently happens that the clavicle is pushed upwards by the pressure of the tumour beneath it—a complication of considerable moment in reference to the operation, the difficulties of which are greatly increased by it. The pressure of the tumour may give rise to serious consequences upon neighbouring parts; thus it may produce a carious state of the first and second ribs, and the compression of the brachial plexus of nerves will occasion pain and numbness in the upper extremity. In some cases the brachial artery beyond the tumour would appear to be obstructed, no pulsation being perceptible in it; and the compression of the axillary vein may occasion oedema of the hand and arm, with some diminution in the temperature of the limb; and these symptoms, if the tumour attain a very large size, may even amount to indications of impending gangrene.

DIAGNOSIS.—The diagnosis of axillary aneurism is usually readily made; there being but two diseases with which it can well be confounded, viz., chronic enlargement and suppuration in the glands of the axilla, and pulsating tumour of the bones in this region. From glandular or other abscess, the diagnosis is generally easy; but I have seen some cases in which, pulsation being communicated to their contents by the subjacent artery, it was somewhat difficult to distinguish the nature of the tumours. Here, however, the history of the case and its speedy progress to pointing will indicate its true nature. From medullary tumour, or osteo-aneurism of the head of the humerus, the diagnosis is not always so easy; and there are at least two instances on record in which the subclavian artery has been ligatured for disease of this kind on the supposition of its being an aneurism. In these instances it has, however, generally been observed that the tumour first made its appearance on the forepart of the shoulder, and not in the usual situation of axillary aneurism; that it was from the first, firm, smooth, elastic, but nearly incompressible; and that, although it presented distinct pulsation, there was no true bellows-sound, but rather a thrilling bruit perceptible in it. The most important diagnostic mark, perhaps, is the fact of these tumours forming a prominence in situations in which aneurisms of the axillary artery would not at first show themselves, as at the upper, outer, or anterior part of the shoulder. In more advanced stages, when the substance of the bone has undergone absorption and its shell has become thin and expanded by the outward pressure of the tumour, there is often a dry cracking or rustling sound perceived on pressure, which is never met with in cases of aneurism.

TREATMENT.—I am not acquainted with any instance in which an aneurism of the axillary artery, not arising from wound or injury, has undergone spontaneous cure, or been consolidated by constitutional treatment. Nor is it probable that compression can ever be made applicable to aneurisms in this situation; inasmuch as the pressure, that is brought to bear upon the subclavian, must necessarily at the same time influence the

whole or the greater part of the brachial plexus of nerves to such an extent as to be unendurable by the patient. Ligature of the artery is therefore the surgeon's sole resource in the treatment of these cases. The part of the vessel universally selected for the application of the ligature is, in accordance with the Hunterian doctrines, that which lies on the first rib beyond the scalenus anticus muscle; this part presenting the advantages of being sufficiently removed from the seat of disease to ensure the probability of the coats of the artery being in a sound state, of being by far the most accessible, and, when deligated, of allowing the collateral circulation by which the vitality of the arm is to be maintained to remain uninjured. Notwithstanding these obvious advantages presented by the ligature of the subclavian over that of the axillary artery, in other words, by performing Hunter's instead of Anel's operation for the cure of spontaneous axillary aneurism, there would appear to be a tendency in the minds of some surgeons to advocate the latter instead of the former of these operations; and to substitute for one that offers the advantages that have just been mentioned a procedure that is not only much more difficult in its performance, and that interferes with the collateral circulation, but that is practised upon a diseased part of the vessel, in dangerous proximity to the sac.

LIGATURE OF THE SUBCLAVIAN IN THE THIRD PART OF ITS COURSE.—In order to apply a ligature to that portion of the subclavian artery which intervenes between the acromial edge of the scalenus anticus and the lower border of the first rib, the patient should be placed in the recumbent position, the arm depressed as much as possible, and the head turned somewhat to the opposite side. The integuments of the lower part of the neck should then be put on the stretch by being drawn downwards over the clavicle, and an incision about four inches in length made upon the bone through the integument, the superficial fascia, and the platysma. When tension is taken off the part, this incision will be found to traverse the base of the inferior triangle of the neck; a vertical incision should then be made at right angles to, and falling into the centre of, the first, and the two flaps of integument and fascia should then be turned up. A quantity of loose cellular tissue will now be exposed, in which a venous plexus and the lower end of the external jugular vein will commonly be found. These vessels should be carefully avoided, and the cellular tissue dissected or scratched through with the point of a knife and a blunt probe; should any vein be wounded, a double ligature must be passed underneath it, or either end tied. If the transversalis colli or humeri arteries, as occasionally happens, should inconveniently traverse this place, they must be drawn out of the way with a blunt hook. By the combined action of cutting and scratching through the cellular tissue, the external edge of the scalenus anticus is reached; this is the "directing line" down which the finger is run until the tubercle of the first rib is felt. This is the guide to the artery, which will be found immediately above and a little behind it, covered, however, and bound down to the rib by a dense fascia. This must now be very carefully opened with the edge of the knife, and the needle passed from before backwards. In doing this, attention must be paid to the brachial plexus, situated above and behind the artery.

There are several points in connection with this operation that deserve special attention. In the first place, it is necessary that the shoulder should be depressed as far as possible, so as to bring the superior margin of the clavicle down. This is a matter of much importance; for, if the clavicle be thrust upwards by the pressure of a large aneurism, the surgeon will have to find the artery at the bottom of a deep narrow wound, instead of on a

comparatively plain surface. A case occurred to Sir A. Cooper, in which the attempt to ligature the subclavian artery for a large aneurism of the axilla was forced to be abandoned, in consequence of the clavicle being thrust up to too great a height to enable him to reach the vessel. The extent of the difficulty occasioned by this elevation of the clavicle must necessarily depend in a great measure upon the height at which the subclavian artery happens in any particular case to be situated in the neck. It is not uncommon to find it pulsating so high in the neck, that an aneurism of elevation of the clavicle by subjacent anillary aneurism might rise that was above the level of the vessel. In the majority of cases, however, it is situated below the level of the bone, or very slightly raised above it, so that, if the clavicle were thrust upwards and forwards, the vessel would be buried in a deep pit behind it. Dupuytren was of opinion that the artery coursed high in persons who were thin, with slender long necks; whereas, in thick, short-necked persons, with muscular shoulders, it was deeply seated. I have often verified the truth of this observation, both in dissection and in examining the pulsations of the vessel during life.

In order to obviate the difficulty that has occasionally been experienced in reaching the artery when thus buried behind an elevated clavicle, it has been proposed by Hargrave to saw through the bone. The most serious objection that can be raised against this practice is the fact of the clavicle being sometimes a part of the wall of the aneurism; but, supposing the surgeon could satisfy himself that this was not the case, I cannot see any objection to this procedure, provided any very great and insurmountable difficulty presented itself in getting the ligature round the vessel without it.

In passing the needle round the subclavian, care must be taken that some of the lower cords of the brachial plexus be not included in the loop: and indeed the mistake has more than once been committed of tying these nervous trunks instead of the vessel. Thus, Liston, in the first successful case of ligature of the subclavian in this country, passed the thread round the lower nervous cord; but, immediately perceiving his error, turned it to account by drawing aside the included nerve, and thus more readily exposing the artery. Dupuytren, in a case of aneurism of some years' duration, succeeded, after an operation that lasted one hour and forty-eight minutes, and which he describes as the most tedious and difficult he ever attempted, in passing a ligature round the vessel, as he believed. After the death of the patient, which occurred from hemorrhage on the fourth or fifth day, the fourth cervical nerve alone was found included in the noose. In a case related by Porter, it is stated that the artery communicated such distinct pulsation to the inferior nervous trunk, that there were no means of ascertaining whether it was the vessel or not, except by passing the needle under it.

In some cases, as has already been stated, the sac passes upwards below the clavicle into the inferior posterior triangle of the neck; when this is the case, the surgeon incurs the risk of puncturing it from its close proximity to the artery, as it lies on the first rib. This accident happened to Cusack while ligaturing the subclavian in the third part of its course, for a diffused aneurism of the axillary artery. An alarming gush of blood took place, which was arrested by plugging the wound; but the hemorrhage recurred on the tenth day, and the patient died. In a case related by Travers, in which the sac was punctured by the needle, which was being passed round the artery, the blood, which was arterial, did not flow per saltum, but

in a continuous stream. "The hemorrhage," Travers says, "was more terrific and uncontrollable than I have ever witnessed," and was not commanded by drawing the ligature tight. It was so great that it was doubtful whether the patient would leave the theatre alive, and was only arrested by plugging the wound with sponge-tents. The patient died of inflammation of the pleura. On examination, the aneurismal sac was found to have a pouch-like enlargement upwards, overlying the artery, where it had been punctured.

LIGATURE BETWEEN THE SCALENI.—If the sac encroach upon the neck, rising above the clavicle, or the artery be not sound in the third part of its course, it may be necessary to ligature it between the scalmi, dividing the outer half or two-thirds of the scalenus anticus. This operation should not be considered as distinct from ligature of the vessel in the third part of its course, but rather as an extension of that proceeding, if it be found, for the reasons just mentioned, unadvisable to tie the artery on the first rib; in this way it has been practised by Dupuytren and Liston. In its first steps, as far as the exposure of the scalenus anticus, it is the same as that for the deligation of the vessel in the third part of its course. When this muscle has been exposed, a director must be pushed under it, upon which it is to be divided to the extent of half or two-thirds its breadth, when it retracts, exposing the vessel. During this part of the operation, some danger may be incurred to the phrenic nerve, and to the transversales colli and humeri arteries; but if ordinary care be taken, this will not be very great. The phrenic nerve, as I have found by very frequent examinations on the dead body, lies altogether to the tracheal side of the incision, if that be not carried beyond one-half the breadth of the muscle; and should it appear to be in the way, it may readily be pushed inwards towards the mesial line, being only loosely invested by cellular tissue. I have, however, seen one instance in which the right subclavian artery was ligatured for a spontaneous cylindrical aneurism of the axilla, and the patient died on the eighth day, of pneumonia; on examination after death, the edge of the scalenus was found cut, and the phrenic nerve divided. Had the injury to the nerve in this case anything to do with the pneumonia? I do not think it improbable, as division of one phrenic, by paralysing to a certain extent the diaphragm, and so far interfering with the respiratory movements, must necessarily have a tendency to induce congestion of the lung, which would readily run on to inflammation of that organ. I have likewise heard of one case in which incessant hiccough followed this operation, and after death the phrenic nerve was found reddened and inflamed, having probably in some way been interfered with during the exposure of the vessel.

Another important point in reference to the ligature of the vessel in this part of its course, is the frequency with which a branch arises from the subclavian artery between the scalmi. When this peculiarity exists, there would probably be but a slender chance of the occlusion of the artery by ligature in this situation. The transversales colli and humeri arteries, though in some danger, whilst crossing over the scalenus anticus, may be avoided by keeping the incision in the muscle between and parallel to these vessels. One principal danger in ligaturing the subclavian artery at any point above the first rib, certainly arises from interference with the fine cellular tissue which lies between it and the scalenus muscles, separating it from the pleura, and which is continuous with the cellular membrane of the anterior mediastinum, being indeed the deep portion of the ascending layer of what Sir A. Cooper has described as the "thoracic fascia," and which tends to form the superior boundary of the chest, being continuous in the neck with the deep

corvical fascia. After the deeper layers of the corvical fascia have been opened, this fine cellular membrane presents itself; and, if inflammation be excited in it, the morbid action will readily extend by mere continuity of tissue into the thorax by the anterior mediastinum, invading ultimately the pericardium and pericardium. Hence, whenever it is practicable, the surgeon should keep the point of the needle close to that part of the artery which lies upon the first rib, as there is less risk here of opening into the deep cellular tissue of the neck.

ACCIDENTS FOLLOWING LIGATURE OF THE SUBCLAVIAN.—The general result of the ligature of the subclavian artery in the third part of its course, for spontaneous aneurism in the axilla, is by no means satisfactory. Thus, of forty-eight cases of aneurism of the axillary artery, not dependent upon any external wound, in which the artery was ligatured above the clavicle, I find twenty-three cures against twenty-five deaths. This result is so unfavourable, and so different, indeed, from what I anticipated, that I have been led to analyse carefully the causes of death. I find them as follow:—

Inflammation within the chest, &c.	10 cases.
Suppuration of the sac	6 "
Suppurative phlebitis	1 "
Hæmorrhage	3 "
Gangrene of hand and arm	1 "
General gangrene	1 "
Not stated	3 "
	<hr/> 25 "

Thus it will be seen that the two most frequent causes of a fatal result following the operation for axillary aneurism, are not those that are usually met with after the ligature of the larger vessels. It would therefore appear to be owing to some special condition, dependent either upon the application of a ligature to the subclavian artery in the third part of its course, or upon the situation and nature of the disease for which that operation is had recourse to; and the important point to be determined is, whether these conditions are the accidental or the necessary consequences of the application of a ligature in this situation for the cure of aneurism in the axilla.

Inflammation of the Contents of the Thorax proved fatal in 10 out of 25 cases, or 1 in 2.5, and is the most frequent cause of death, though not, I believe, the most frequent untoward complication of this operation. It might at first be supposed that, in this respect, the operations on the subclavian artery resembled other of the greater operations, after which pneumonia is so common a sequela; but, on closer examination, it will be found that this is not the case. Inflammation, when attacking the thorax or its contents after ligature of this artery for axillary aneurism, is not confined to the lungs, but very commonly affects the pleura and pericardium as well as, or even in preference to, these organs. It would, therefore, appear probable that it arose from causes that are essentially connected with this disease or operation. These are referrible to three heads.

1. Inflammation of the deep cellular tissue at the root of the neck may extend to the anterior mediastinum, the pleura, and pericardium. This would appear to have been the cause of death in a patient in whom Key tied the subclavian, and has been especially adverted to by that excellent surgeon in his relation of the case.

2. The sac may, by its pressure inwards, encroach upon and give rise to inflammation of that portion of the pleura that corresponds to its posterior aspect. This occurred in a case in which Mayo of Winchester operated,

and is more liable to happen if suppuration has taken place in the sac; when this happens, adhesion may take place between it and the pleura, or even the tissue of the adjacent lung; and the contents of the suppurated tumour may be discharged into the pleural cavity or air-tubes, and so coughed up. Of this curious mode of termination there are at least two cases on record: one by Bullen, in which the patient recovered; the other by Dr. Gross, in which the patient died from the escape of the contents of the sac into the cavity of the pleura.

3. Division of the phrenic nerve would necessarily, by interfering with the respiratory movements, induce a tendency to congestion and inflammation of the tissue of the lungs; and, although such an accident must be a very rare one in cases of ligature of the subclavian for axillary aneurism, yet it undoubtedly has occurred, as I have myself witnessed in one case.

Suppuration of the Sac is the most common, though not the most fatal, accident after ligature of the subclavian for spontaneous axillary aneurism. It was the immediate cause of death in six cases, and occurred in two of the patients that died of inflammation of the chest; it also took place in six cases that recovered: in all fourteen cases out of forty-five, or nearly one in three, — a much higher proportion than is generally observed in cases of ligature for aneurism.

What occasions this greater frequency of suppuration of the sac in axillary aneurisms than in those in other situations? The only cause to which it appears to be attributable is the great laxity of the cellular membrane in the axilla, which allows the tumour to increase so rapidly in size as to excite inflammatory action in the surrounding tissues, which may speedily run into suppuration. So long as the contents of the tumour continue fluid, they will necessarily excite less irritation on surrounding structures; but when once they have become solidified, whether by the gradual deposition of laminated fibrine, during the progress of the disease, or more suddenly, in consequence of those changes that take place in the contents of an aneurismal sac after the ligature of the artery leading to it, the indurated mass, acting like any other foreign body, sets up inflammation in the cellular tissue that is in immediate contact with it, and thus disposes it to run into suppuration. The more speedily the solidification takes place, the more disposition will there be to the occurrence of this accident; the neighbouring parts being unable to accommodate themselves to the sudden extension and compression they are compelled to undergo.

The period at which suppuration of the sac may be expected to occur in cases of axillary aneurism, after the ligature of the subclavian, must necessarily in a great measure be dependent on the state of the sac at the time of the operation. If inflammatory action have been already set up around it, it may happen in a few days after the artery has been tied. But if this morbid action have not already commenced, the period at which suppuration may most probably be expected is between the first and second month. The period at which suppuration and rupture of the sac take place does not influence the probable termination of the case to any material extent; as, in the cases that proved fatal, death occurred at various periods between the seventh day and the second month; in Aston Key's case, on the ninth day; in Mayo's, on the twelfth; in Belandini's and Grafe's, at the end of the first month; in Rigaudi's, at the sixth week; in B. Cooper's, in the second month. The recoveries, likewise, took place at all periods after the ligature of the vessel, between a few days, as in Porter's, and six weeks, as in Halton's case.

An axillary aneurism that has suppurated may burst either externally, or

into the lungs or pleura, or both. It is most usual for it to burst externally; the tumour enlarges, with much pain and tension; a part of the covering it becomes inflamed, fluctuation can be felt, and if it bursts the tumour will give way, discharging most usually a quantity of dark-coloured pus, mixed up with more or less tawny-brown and disintegrated coagulum and fibrinous deposit, and perhaps sooner or later followed by a stream of arterial blood.

Occasionally, but more rarely, the sac extending backwards becomes adherent to the pleura, and may give way into that cavity; or, by pressing against, may become incorporated with the lungs. Of this remarkable termination two instances are recorded, in one of which recovery took place.

The first case of the kind is one in which Bullen ligatured the subclavian artery for axillary aneurism. Eighteen days after the operation the tumour began to increase, and to take on the symptoms that are indicative of suppuration. On the twenty-sixth day, six or eight ounces of bloody pus were expectorated during a paroxysm of coughing, and the tumour suddenly diminished to one-half its size; it was now punctured, and five ounces of the same kind of matter let out with great relief. When the patient coughed, air passed into and distended the sac through an aperture between the first and second ribs, near their sternal extremities, through which the contents of the tumour had escaped into the lung. The discharge from the external aperture greatly decreased; the cough lessened; and finally, three months after the operation, the patient was quite well.

Dr. Gross tied the subclavian artery for axillary aneurism on the 18th of February. After the performance of the operation the contents of the tumour solidified, and its volume progressively diminished. On the 15th of March, the patient suffered from fever, and slight tenderness on the apex of the tumour was perceptible. On the 16th he was suddenly seized with intense pain in the chest, which was particularly severe at the base of the right lung, and extended up towards the axilla. The respiration throughout the right lung was bronchial, and there was dulness on percussion over the lower ribs; the aneurismal tumour had suddenly disappeared at the time of the attack. On the 18th, the patient experienced a sensation as if a fluid were passing from the pleuritic cavity into that of the aneurismal tumour; and, upon auscultating, a plashing sound was heard at every inspiration, the noise resembling that produced by shaking water in a closed vessel. On the 20th, he died. Upon dissection, the aneurism was found to communicate by an aperture, one inch and three-quarters in length and an inch and a half in width, with the pleural cavity; this opening was situated between the first and second ribs, and was obviously the result of ulceration and absorption, caused by the pressure of the tumour. Both ribs were denuded of their periosteum. The right side of the chest contained nearly three quarts of bloody serum, intermixed with laminated clots and flakes of lymph; the fibres of which had evidently been lodged originally in the aneurismal sac (*North. Am. Journ.*, 1845, p. 19).

Besides these cases, a somewhat similar one has been recorded by M. Neret, of Nancy. A patient was admitted into the hospital, labouring under hemoptysis, and on examination was found to have an aneurism of the left subclavian artery as large as a chestnut. He died shortly after admission; and, on examination, the aneurism was found to communicate with a large cavity in the upper part of the lung.

The cause of death in Dr. Gross's case was probably the fact of the sac opening and discharging its contents into the pleural cavity. This does not appear to have occurred in Bullen's, in which a communication was

established directly with the lung, the contents of the abscess finding exit through the air-tubes. The process here was analogous to what occasionally occurs in hepatic abscess when this opens through the lungs, adhesion having previously taken place between the opposed surfaces of the pleura.

The principal danger, and the most frequent cause of death after the suppuration of the sac, is the supervention of profuse arterial hemorrhage. This may either occur from the distal extremity of the artery opening into the sac, or from one of the large branches which serve to support the collateral circulation round the shoulder, such as the subscapular or posterior circumflex, coming off either immediately above or below the sac, or from the sac itself. When hemorrhage does not take place after the suppuration of the sac, it must be from the fortunate circumstance of the occlusion of the main trunk, where it opens into the tumour. It can scarcely be from the occlusion of the principal collateral branches; as there would, in this event, be a difficulty in the preservation of the vitality of the limb. It is easy to understand that, if the sac spring from the axillary, at a little distance above the orifices of the subscapular and circumflex arteries, all that portion of the main trunk which intervenes between the tumour and these vessels might be occluded, and thus hemorrhage be prevented on suppuration taking place; whilst the collateral circulation would take place uninterruptedly through these vessels. If this portion of the artery have not been occluded by inflammatory action, the safety of the patient must depend upon the accident of a coagulum or piece of laminated fibre being fixed or entangled in the mouth of the sac. This may prevent for a time the escape of arterial blood, which, on such a plug being loosened, may break forth with impetuosity, and either at once, or by its recurrence at intervals, carry off the patient.

Another danger may be superadded in these cases on the suppuration of the sac and the supervention of hemorrhage—namely, the occurrence of inflammation of the pleura, lung, and pericardium, from the extension inwards of the morbid action going on in the sac.

Secondary Hemorrhage does not frequently occur in cases of ligature of the subclavian artery in the third part of its course, except as a consequence of suppuration of the sac. I am acquainted with two cases only in which death occurred from the hemorrhage taking place from this artery at the part ligatured. One of these happened to Liston, and the preparation is preserved in the Museum of the College of Surgeons (No. 1695). In this case, it may be seen that the artery was diseased at the point ligatured, and that the bleeding occurred, as usual, from the distal side of the ligature.

Gangrene of the Hand and Arm is but seldom met with as a sequela of the operation we are considering. This is doubtless owing to the freedom of the anastomosing circulation between the branches of the transversales colli and humeri, and those of the subscapular, circumflex, and thoracic acromial arteries; as well as between the superior thoracic and the branches of the first and second intercostals and internal mammary, by which the vitality of the limb is readily maintained. The principal risk from gangrene would doubtless arise from the subscapular artery being in any way occluded or implicated in the disease, as it is on the anastomoses of this vessel that the limb is mainly dependent for its supply of blood. But, at all events, this danger is small, the only case in which it appears to have given rise to a fatal termination being one in which Collis tied the artery; gangrene of the limb came on after much constitutional disturbance of a low type, with rapid, weak pulse, thirst, sweats, restlessness, and delirium. In Bizard's case, there was sloughing of the sac, and pericarditis, the gangrene

being confined to two fingers; and in Brodie's case, it occurred in both the lower as well as in the upper extremities, and must, therefore, have proceeded from some constitutional cause altogether independent of the mere arrest of circulation through the subclavian.

TREATMENT OF INFLAMED AXILLARY ANEURISM THREATENING SUPPURATION.—The case of an axillary aneurism becoming inflamed, and threatening to run into suppuration before the surgeon has had an opportunity of ligaturing the subclavian artery, is one that is full of important practical considerations, and that admits of little delay; for if the sac ruptures, or be opened, fatal hemorrhage is the necessary and inevitable result. It would obviously be impossible, in a case of spontaneous aneurism, with any fair chance of success to lay open the tumour, turn out the coagula, and ligature the vessel above and below the mouth of the sac; the coats of the artery, being not only diseased, but still further softened by inflammation and supervening suppuration, would not be in a condition to hold a ligature. There are two other courses open—viz., ligature of the vessel, or amputation at the shoulder-joint; and in the selection of one or other of these, the surgeon must be guided by the progress the disease has made, the condition of the limb as to circulation and temperature, and the solidity or fluidity of the contents of the tumour.

If the tumour be of moderate size and circumscribed, and the arm of a good temperature and not very cedematous, *ligature of the artery* may hold out a reasonable chance of success. It is true that this is but a chance: for the blood will, immediately after the noose is tied, be carried by the suprascapular and posterior scapular arteries into the subscapular and circumflex, and by them into the axillary at no great distance from the mouth of the sac; or it may enter directly into the mouth of the latter if the profunda or circumflex should chance to take their origin from the dilated portion of the vessel. Hence, the only safeguard against the supervention of hemorrhage as soon as the sac has burst or been opened, or has discharged its contents, will be the occlusion by inflammatory action of that portion of the artery which intervenes between these two collateral branches and its mouth, or the accidental entanglement in the latter of a mass of laminated fibrine. Yet, under the circumstances as to the condition of tumour and limb that have just been mentioned, it would be but right for the surgeon to give the patient a chance of preserving his limb.

Should, however, hemorrhage occur on or after the discharge of the contents of the sac, the subclavian having previously been ligatured, what should be done? If the bleeding be moderate, an attempt should be made to arrest it by plugging the wound, and by the application of a compress and bandage. If it recur, or be so profuse as to threaten the life of the patient, what course should the surgeon then pursue? Two lines of procedure are open to him: either to cut through the pectoral muscles so as to lay the sac open fully, and attempt to include the bleeding orifices between two ligatures; or to amputate at the shoulder-joint.

If a surgeon were to undertake the first of these alternatives in a case of spontaneous aneurism, of which alone we are now speaking, he would, in all probability, find the part in such a condition as would prevent the possibility of his completing the operation he had commenced. After laying open a large sloughing cavity, extending under the pectoral muscles perhaps as high as the clavicle, and clearing out the broken down coagula and grumous blood it contains, in what state would he find the artery? Certainly, the probability would be strongly against its being in such a condition as to bear a ligature, even if it could be included in one. Its coats, in the immediate

vicinity of the sac, could not, in accordance with what we know to be almost universally the case in spontaneous aneurisms of larger size or old standing, be expected to be in anything like a sound, firm state, and would almost certainly give way under the pressure of the noose; or the vessel might have undergone fusiform dilatation, as is very common in this situation, before giving rise to the circumscribed false aneurism, in which case it would be impossible to surround it by a ligature; or, again, the subscapular or circumflex arteries might arise directly from, and pour their recurrent blood into, the sac or the dilated artery, and, as they would lie in the midst of inflamed and sloughing tissues, no attempt at including them in a ligature could be successfully made. Under such circumstances as these, the danger of the patient would be considerably increased by the irritation and inflammation that would be occasioned by laying open and searching for the bleeding vessel in the sac of an inflamed, suppurating, and sloughing aneurism, and much valuable time would be lost in what must be a fruitless operation; at the close of which it would, in all probability, become necessary to have recourse to disarticulation at the shoulder-joint, and thus remove the whole disease at once. I should, therefore, be disposed to have recourse to *disarticulation at the shoulder-joint* at once, in all cases of profuse recurrent hemorrhage, following sloughing of the sac of an axillary aneurism, which could not be arrested by direct pressure on the bleeding orifice, after the subclavian has been tied.

There is another form of axillary aneurism that requires immediate amputation at the shoulder-joint, whether the subclavian artery have previously been ligatured or not; it is the case of diffuse aneurism of the arm-pit, with threatened or actual gangrene of the limb.

LIGATURE OF THE AXILLARY ARTERY.—Should ligature of the axillary artery at any time be required, the vessel may be secured in two ways, in the space that intervenes between the lower margin of the clavicle and the fold of the axilla.

The first way is by an incision, either straight or somewhat semilunar, parallel to and immediately below the inferior border of the clavicle; this must be carried through the pectoral muscle, and when this is divided, some loose cellular tissue, in which the upper thoracic artery ramifies, is exposed. This must be scratched through cautiously, until the fascia covering the vessels is reached. On opening this, which must be done in the most careful manner by making a small aperture in it, and then passing a grooved director under it, the vein first comes into view. This must be drawn downwards, when the artery will be found immediately above and behind it in the deep hollow formed by the clavicle above, and the edge of the lesser pectoral below. This operation is an exceedingly difficult one, on account of the depth and narrowness of the wound and the muscular character of its walls, as well as from the embarrassment occasioned by the numerous venous and arterial branches which ramify across the space in which the artery lies. After the vessels have been exposed, the passage of the ligature round them will be greatly facilitated by bringing the arm to the side of the body, so as to take off all tension from the wound.

The safer and simpler operation consists in making an incision from the centre of the clavicle directly downwards, in the course of the vessels, to the middle of the anterior fold of the axilla. In this way the skin, superficial fascia, and greater pectoral muscle must be successively divided. The lesser pectoral will then be exposed; and the artery may either be ligatured below this, without further division of muscular substance, or, if it be thought desirable to deligate it under this, the muscle must be cautiously cut through. When

this is done, a very distinct and firm fascia will come into view ; this, being pushed up, must be carefully opened, when the artery and vein will be seen lying parallel to one another, the artery not being overlapped by the vein, as it is higher up. The vein having been drawn inwards, the aneurism-needle must be carried from above downwards between it and the artery. The great advantage of this operation is, that the wound is open and free, and that, consequently, the artery can be more readily reached in any part of its course. The disadvantage is the great division of muscular substance that it entails. This, however, need not leave any permanent weakness of the limb, as by proper position ready and direct union may be effected between the parts.

ANEURISM OF THE ARM, FOREARM, AND HAND.

Spontaneous aneurism rarely occurs below the axilla, yet it may occasionally be met with at any part of the upper extremity. Thus Palletta, Flajani, Pelletan, and others relate cases of spontaneous aneurism at the bend of the arm ; and Liston states that he once tied the brachial artery in an old ship-carpenter, who, whilst at work, felt as if something had snapt in his arm. Pilcher has recorded a case of aneurism under the ball of the right thumb, which was produced by repeated though slight blows with the handle of a hammer used by the patient (a working goldsmith) in his trade ; the radial and ulnar arteries were tied immediately above the wrist, and the disease was thus cured. Aneurism has also been met with in this situation after attempted reduction of the thumb. In the Museum of the College of Surgeons there is a preparation of a radial artery with a small aneurism, about the third of an inch in diameter, formed by the dilatation of all the coats of a narrow portion of one-half the circumference of the vessel, a little above the origin of the superficialis volæ. Spontaneous aneurism in the forearm is of extremely rare occurrence. A case has been recorded by Mr. Todd as occurring in a woman twenty-eight years of age, where a spontaneous aneurism in the forearm had existed for several years before the brachial was ligatured, when pulsation in the tumour ceased, though it continued solid and hard for some months after the operation. In 1849, a man was admitted into University College Hospital, for a tumour that presented all the characters of aneurism, situated in the upper third of the ulnar artery of the right forearm. The brachial was ligatured by Mr. Arnott, when pulsation and bruit ceased in the tumour, though slight enlargement of the arm continued for some time afterwards.

Rare as spontaneous aneurisms are in these situations, the traumatic forms of the disease are, as has already been stated (page 197), of frequent occurrence, and may require the ligature of the brachial, or of either of the arteries of the forearm.

TREATMENT.—In cases of aneurism below the axilla, direct pressure might be tried with advantage, provided the tumour be of small size and unattended by inflammation of the superjacent integuments. Compression of the trunk of the artery above the tumour is rarely applicable, on account of the pain that is induced by the pressure upon the neighbouring nerves which cannot be isolated from the artery. Besides this, the brachial artery is so mobile, and the humerus so small and round a bone, that the vessel cannot be steadily compressed against it for any length of time ; it will roll away from under the pressure, even if the patient could bear the pain of it.

LIGATURE OF THE BRACHIAL ARTERY.—The brachial artery may be ligatured in the middle of the arm, which is considered the seat of election of this operation, by making an incision, about three inches long, parallel

to and upon the inner edge of the biceps, which is the "directing line;" the fascia, which is exposed, must be opened carefully to a corresponding extent, when the median nerve will commonly be seen crossing the wound, this must be drawn downwards with a blunt hook, when the artery, accompanied by its two veins, will be exposed; these vessels must then be separated from one another, and the ligature passed and tied in the usual way. In performing this operation, the principal point to attend to is to cut down upon the inner edge of the biceps, which will be the sure guide to the artery. If the surgeon keep too low, he may fall upon the ulnar nerve and the inferior profunda artery, which might possibly be mistaken for the brachial; but by taking care to expose the lower fibres of the biceps in his early incision, he will avoid this error.

In the upper part of the arm, the brachial artery, where the axillary terminates in it, will be found lying immediately behind and covered by its vein. On drawing this to the inner side, the artery will be seen, the plexus of nerves being somewhat above and behind it. In ligaturing the artery in this situation, care must be taken to divide the integuments, which are extremely thin, with great caution; by rotating the arm outwards and bending the elbow, the artery will be thrown forward and rendered less tense, so that a ligature can easily be passed round it.

At the bend of the arm, the brachial artery may be reached by making an incision, about two inches in length, in a direction downwards and inwards, about half an inch internal to the edge of the tendon of the biceps. After carrying it through the skin and fascia, the vessel will be found accompanied by its veins, in the triangular space bounded externally by the biceps tendon, and internally by the pronator teres. In performing this operation the veins at the bend of the arm, with the filaments of the internal cutaneous nerve, must be divided to some extent, though they should be spared as much as possible. The artery will be found, about half an inch to the inner side of the tendon, accompanied by the median nerve, which is to its ulnar side.

LIGATURE OF THE RADIAL AND ULNAR ARTERIES.—These arteries should never, I think, be ligatured above the middle third of the arm, except in cases of direct wound. Any attempt at tying them in the upper part of the forearm will not only be attended with great difficulty, but with the danger of crippling the muscles in this situation, and thus impairing the after-movements of the arm. Ligature of the brachial artery may always be substituted advantageously.

The *Radial Artery* may be ligatured near the wrist, by making an incision, about two inches in length, half an inch to the outside of the tendon of the flexor carpi radialis—the "directing line;" when, after the division of the superficial and deep fascia, the artery, accompanied by its two veins, will be exposed, and may be tied in the usual way.

The *Ulnar Artery* above the wrist may be readily ligatured by making an incision about two inches in length, a little above and one-third of an inch to the radial side of the pisiform bone, parallel to the tendon of the flexor carpi ulnaris, which is the "directing line" to the vessel. After the fascia covering it has been divided, the artery, with its two accompanying veins, will be found to the radial side of the ulnar nerve.

CHAPTER XLIII.

ANEURISMS OF THE LOWER EXTREMITY.

INGUINAL ANEURISM.

AN *Iliac* or *Inguinal Aneurism* may arise from the external iliac, or from the common femoral artery; most frequently it springs from the latter, and, taking a direction upwards, pushes the peritoneum before it, and thus encroaches somewhat upon the cavity of the abdomen. The aneurism is commonly of the circumscribed false variety, though sometimes tubular. It never becomes diffused, for the reason long ago pointed out by Scarpa, that the femoral artery, above the edge of the sartorius muscle, is invested by so dense a sheath, and is so closely bound down to the neighbouring fascia, that, when dilated into an aneurism, it does not readily give way.

SYMPTOMS.—When first noticed, the aneurism is a small, soft, compressible tumour, with pulsation and bruit, and is generally attended by little pain or uneasiness. It rapidly enlarges, however, and may attain a considerable magnitude; being often somewhat lobulated upon the surface, owing to the unequal constriction exercised on it by the fasciæ under which it lies. At the same time, it usually becomes more solid; and the pulsation in it diminishes considerably, or even ceases entirely. As it increases in size, it compresses the saphena and femoral veins, thus giving rise to œdema of the limb; and, by stretching the genito-crural and some of the branches of the anterior crural nerve, it occasions considerable pain in the thigh and leg.

DIAGNOSIS.—The diagnosis of inguinal aneurism is not always so easy as might at first appear. It has most frequently been confounded with abscess in the groin, with carcinomatous tumours in this situation, and with osteo-aneurism. The diagnosis from abscess must be made on general principles; but in some instances it appears to be replete with difficulty, as there are not a few cases recorded in which aneurisms in this situation have been mistaken and punctured for abscess, an error that has in every instance proved fatal. The diagnosis of an inguinal aneurism, solidified by the deposition of laminated fibrine, and pulsating but indistinctly from a *pulsating encephaloid* or *osseous tumour* in the groin, is surrounded by the greatest difficulty, and cannot, I believe, with the means we at present possess, be accomplished with absolute certainty. The fact of the two diseases having in two instances been confounded during the last few years, by two of the most distinguished surgeons of the day, Mr. Stanley and Mr. Syme, is sufficient evidence of the difficulty attending their diagnosis.

TREATMENT.—It occasionally happens that inguinal aneurisms, even of a very large size, undergo spontaneous cure, or become consolidated by direct pressure conjoined with constitutional treatment; but these instances are of such rare occurrence, that such a result cannot be relied on in any one case. In the majority of instances the tumour, though it may have encroached on the abdomen, will not have reached too high for the external iliac to be ligatured; should it have done so, however, the surgeon may have to tie the common iliac artery; but in some instances even this may not be practicable, and his choice must lie between the slender chance offered by constitutional treatment and pressure, and the fearful alternative of ligaturing the aorta.

LIGATURE OF THE EXTERNAL ILIAC ARTERY was first practised by Abernethy, in 1796. Since that period it has been had recourse to in at least 100 instances for inguinal aneurism (Norris); of these seventy-three were cured, and twenty-seven died. In one remarkable case, both external iliacs were ligatured successfully at an interval of eleven months, by Mr Tait. In some few cases also, there was the complication of an aneurism in the ham with that in the groin. Of the ninety-two cases in which the aneurism was solely seated in the groin, seventy were cured, and twenty-two died. Death resulted from gangrene of the limb in eight, from secondary hemorrhage in four, from sloughing of the sac in three, from tetanus in three, and from causes of a more general character in four cases.

Pulsation returned in the sac in six cases; in some not until several weeks had elapsed after the operation; and in one instance only was this phenomenon followed by death. *Suppuration of the sac* was of frequent occurrence, happening in thirteen instances, doubtless owing to the large size that these

tumours are often allowed to attain before being subjected to surgical interference. It is remarkable, however, that in three cases only was this accident fatal; and in two of these three instances the sac had been opened before the operation, on the supposition of its being an abscess. *Secondary hemorrhage* occurred but in six cases, four of which proved fatal; a very small proportion when compared with what happens in other situations. This must doubtless be attributed in a great measure to the absence of any collateral branches springing from the trunk of the external iliac; the distance between the point ligatured and the epigastric and circumflex iliac arteries affording abundant space for the safe obliteration of the vessel. In one of the fatal cases, pulsation had previously returned in the sac; in the other three the patients died on the seventeenth, the twenty-seventh, and the forty-third days respectively.

Gangrene of the limb is the most common cause of death after deligation of this vessel. It occurred in nine instances, of which eight proved fatal; one being cured by amputation. The period at which the mortification supervened varied from the third to the fourth week. The principal cause of this gangrene is narrowing or obliteration of the neighbouring venous trunk, by pressure of the tumour. In the accompanying woodcut (Fig. 210), this is well illustrated; the vein opposite the aneurism being completely closed.



Fig. 210.—Obliteration of Femoral Vein by Inguinal Aneurism.

It is a very remarkable circumstance in the history of this operation that three deaths have resulted from tetanus, a most unusual occurrence after the ligature of arteries.

The ligature of the external iliac for aneurismal varix in the groin affords a striking contrast with that for spontaneous aneurism; the four cases recorded all proving fatal, two dying of gangrene, and two of hemorrhage. In these cases Guthrie has recommended that the tumour should be laid

organ, and the artery ligatured above and below the aperture in it. But, with whatever rapidity and dexterity such a proceeding may be accomplished in the groin, there will be great risk of such a loss of blood ensuing as to endanger the patient's life, there being great difficulty in commanding the artery above the seat of disease.

Aneurism occasionally takes place in the groin and ham of the same side; here the ligature of the external iliac will cure both diseases. Of four cases in which this complication occurred, the operation was successful in three; one patient dying of gangrene, and in him the popliteal aneurism was on the point of bursting at the time of the operation. In two of the three cases that recovered, pulsation returned in the inguinal aneurism, but disappeared after a time.

Operation.—There are two modes of tying the external iliac artery—the one originally practised by Abernethy, somewhat modified by Liston; and the other introduced by Sir A. Cooper.

Abernethy's method modified consists in commencing an incision two finger-breadths above, and somewhat to the inner side of, the middle of Poupart's ligament, and carrying it upwards and outwards to the extent of about four inches, so that it terminates at about three finger-breadths to the inner side of the anterior superior spine of the ilium. After dividing the skin and superficial fascia, the fibres of the external oblique tendon are carefully cut through. The internal oblique and the transversalis muscles are then cut through with great caution, when the transversalis fascia is reached, which is recognised by its dull-white appearance. A small portion of this membrane, at the lower angle of the wound, where it is thinned and expanded for the passage of the cord, is now carefully raised with the forceps and scratched through with the point of the scalpel. A director is then introduced, and passed underneath it, when it should be laid open upwards and outwards to the full extent of the wound; the whole of the inner side of the wound is next drawn towards the mesial line, the peritoneum being separated from its loose cellular connections in the iliac fossa by the surgeon's fingers; it must be kept out of the way by an assistant, who holds it up with a broad bent copper spatula. The artery may now be felt pulsating at the bottom of the wound, covered by a dense fascia, and having the vein lying to its inner side, and somewhat behind it. The investing sheath must be scratched through in two situations, and the needle passed from the inner side between the vessels, the ligature being then tied in the usual way.

In *Sir A. Cooper's operation*, an incision about three inches in length is made a little above and nearly parallel to Poupart's ligament, beginning above the inner margin of the abdominal ring, and ending near the anterior superior spine of the ilium. By this incision the tendon of the external oblique is exposed, and must be divided to the full extent of the external wound, when the spermatic cord will be seen passing under the lower edge of the internal oblique and transversalis muscles. Some loose cellular tissue and fascia has now to be scratched through; and the finger, being passed under the cord, will come into contact with the external iliac artery, close to the spot where the epigastric is given off from it; the upper side of the incision must now be well raised by a copper spatula, when the vessel will be exposed, covered by a cellular sheath, and having the vein to its inner side; the sheath must be cautiously opened, and the ligature passed in either direction.

On comparing the two operations, it would appear that the principal disadvantage of *Abernethy's* is, that it is apt to leave a tendency to hernial protrusion, in consequence of the abdominal wall being much weakened by

the free incisions through the muscular planes that are necessary ; the great advantage attending it is, that the external iliac may be ligatured at any part of its course, and that, if requisite, the incision may be even extended upwards, and the common trunk secured. In Sir A. Cooper's operation, the line of incision lies directly across the course of the epigastric artery, which, as well as the circumflex ilii, if it arise high, and the circumflex vein, which crosses the iliac artery at this point, and is often somewhat funnel-shaped, may be in danger of being wounded. The spermatic cord is likewise somewhat in the way in this operation. Dupuytren actually wounded the epigastric artery in one case ; and Houston had much difficulty from the circumflex vein in another instance. This operation has also the disadvantage, that by it it is impossible to prolong the incision upwards so as to deligate any portion of the vessel except that which lies immediately above the crural arch ; but the peritoneum is less disturbed than in the other case, and there is less tendency to hernial protrusion afterwards. As a general rule, I think we may conclude that, in cases of spontaneous aneurism, in which it might, from the size of the tumour or the diseased state of the vessels, be found necessary to apply the ligature to a higher point than was intended before the operation commenced, it will be safer to have recourse to Abernethy's plan, modified as above described, as in this way we shall be able to ligature the vessel at any part of its course ; whilst in cases of hemorrhage after amputation, or of traumatic femoral aneurism, in which the artery is not likely to be diseased, recourse should be had to Cooper's operation, more particularly if the patient be thin, and the abdomen flat.

In connection with the ligature of the external iliac artery, there are some practical points that deserve mention. Before the operation the colon should be emptied by means of an enema, and the pubes shaved. The incision in the abdominal wall must be sufficiently extensive, but should never be allowed to implicate the external ring, lest it give rise to a tendency to hernial protrusion. Care should be taken not to wound the peritoneum ; for although two patients in whom this was done by Post and Tait both recovered, yet it is of course a dangerous accident, and should if possible be avoided. The peritoneum must not be torn up more than is absolutely necessary, lest hemorrhage or subsequent peritonitis occur ; and especial care must be taken that the fascia transversalis be properly divided, otherwise the iliac fascia may be strapped up with the peritoneum, and the artery in this way dragged out of its normal situation into the upper and inner angle of the wound, occasioning great embarrassment to the operator, who may not be able to find it. Before attempting to pass a ligature round the vessel, the dense fascia covering it must be scratched through ; and, lastly, the sac must not be injured by having its peritoneal covering stripped off.

LIGATURE OF THE COMMON ILIAC.—If the aneurism in the groin extend so high that there is not sufficient space for the exposure and ligature of the external iliac artery, it becomes necessary to tie the common trunk. This may be done by extending the incision that serves for the ligature of the external iliac upwards and slightly inwards towards the umbilicus, to an extent corresponding to the degree of obesity of the patient, so that it assumes a somewhat semilunar form. Or a semilunar incision may be made from a point about two or three inches above the umbilicus, and carried downwards and inwards to a corresponding extent below it. The incision is then successively carried through the different planes of muscular fibre with great caution and on a grooved director, until the transversalis fascia is exposed ; this must be carefully opened and freely divided, so as to expose the peritoneum, which now comes bulging into the wound, pressing forward

its contents. This must be held aside, drawn upwards by the fingers of an assistant, and gently stripped from the iliac fossa by the surgeon carefully maintaining his hand beneath it. When he arrives at the bend of the iliac, he will readily be conducted to the external iliac artery, which guides him to the parent trunk. The ligature must then be passed under the artery, a slight scratch having been made through the fascia covering the vessel.

In planning the incision for the ligature of this artery, care should be taken that it be not carried too low down or too far forwards; nothing can be gained by doing so, and there is besides the additional risk of the circumference of the ilium or epigastric being wounded, as happened to Most, and as these are principal agents in the anastomosing circulation, their injury is a serious accident. Should any muscular branches bleed, they had better be ligatured, so as not to obscure the after-steps of the operation. The fascia transversalis should be opened at the lower part of the wound, where it is thinned for the passage of the cord, by pinching up a portion of it with the forceps, and drawing it carefully with the edge of the knife laid horizontally; it will be found to be much thicker and denser at the upper and outer part of the wound than in this situation. When the peritoneum is well drawn upwards to the mesial line by the assistant's finger or copper spatula, the ureter, which crosses the artery in this situation, will be carried up with it, so as not to be seen at all. In this stage of the operation, the patient should be turned on his sound side, in order to prevent the intestines from falling over and pressing the peritoneum into the wound.

In determining the length of the incision, and calculating the point at which he would expect to meet with and ligature the artery, it is a matter of the very first importance for the surgeon to remember the *different bearings of the parts in the neighbourhood of the vessels*, and the *relative frequency with which the origin and termination of the artery correspond with certain fixed points* that may readily be detected.

The points of importance are the relations of the vessels to the lumbar vertebrae, to the crest of the ilium, and to the umbilicus. The ordinary place of division of the abdominal aorta is on the body of the fourth lumbar vertebra, or on the intervertebral disk below it; according to Quain, this was the case in three-fourths of the bodies he examined, or in 156 out of 196. In regard to the relations between the situation of the bifurcation of the aorta and the crest of the ilium, we find it, according to the same anatomist, to have ranged in about four-fifths of the cases about half an inch above and below the level of the highest point of this part of the bone. With reference to the umbilicus no definite rule can be laid down; but in general terms it may be stated that the bifurcation of the aorta is a little to its left. As a general rule, that given by Hargrave is perhaps sufficiently good for ordinary purposes. If a point be taken about half or three-quarters of an inch below and a little to the left of the umbilicus, and a line be drawn on each side from this point to the centre of Poupart's ligament, we obtain about the direction of the common and external iliac arteries. On dividing these lines into three equal parts, the upper third will correspond to the primitive trunk, and the lower two-thirds to the external iliac, and the junction of the upper with the middle third to the bifurcation of the common iliac artery.

The point of division of the common iliac artery is, in the majority of cases, between the middle of the fifth lumbar vertebra and the middle of the sacrum, both points inclusive; and if it be not in this situation the division will probably be lower down.

The length of the vessel varies greatly; according to Quain, in five-

sevenths of the cases it ranged between one-and-a-half and three inches.

Results.—Writing in 1852, I stated that when we look at the depth at which this artery is situated, its great size, and proximity to the centre of the circulation, and consider the force with which the blood rushes through it, we cannot but be struck with the success which has attended its ligation. Of 17 cases in which it had been tied, 8 were cured, and 9 died; in 11 of the cases the ligation was applied for aneurism, and of these 7 recovered. The 4 that died perished rather from the magnitude and extent of the disease than from the effects of the operation; and it is remarkable, as showing the power of the anastomoses in maintaining the vitality of parts, that in no instance did gangrene ensue. Since this period the operation has been performed many times, but with much less satisfactory results. Dr. Stephen Smith, of New York, published the statistics of this operation in 1860, giving the details of 32 cases; of these, he says, 25 died and only 7 recovered. I think the numbers should be 24 and 8; as in one case (Bushe's), the patient (an infant) died two months after the operation, the ligation having separated and the artery being occluded, and thus the deligation having succeeded. Gurlt of Berlin, in reproducing Smith's tables, adds 2 cases, both fatal. To these must also be added a fatal case by Dugus of Charleston, and two in which the operation has, within the last two years, been performed successfully in this country; once by Bickersteth of Liverpool, and once by Syme, in a remarkable case of iliac aneurism, in which that distinguished surgeon laid open the sac and tied the arteries (the common, external, and internal iliacs) opening into it. These cases increase the total number to 37, of which 9 recovered and 28 died; in 9 of the cases the peritoneum was wounded, and of these 8 proved fatal.

Of 13 cases in which this vessel was tied for hemorrhage, 12 proved fatal; of 17 in which it was deligated for aneurism, 7 recovered; and of the remaining 7, of which 6 were for disease (malignant, &c.) only 1 recovered.

LIGATION OF THE AORTA.—It is impossible not to contemplate with admiration the man whose mind was the first to conceive, and whose hand was the first to carry out, the determination to apply a ligation to the abdominal aorta; and who, guided by pathological observation and physiological experiment, dared to arrest at once the circulation through the main channel of supply to the lower half of the body, trusting to the collateral circulation for the maintenance of the vitality of the parts thus suddenly deprived of blood. Sir A. Cooper was the first to place a ligation on the aorta, in 1817. Since that period the operation has been four times performed; viz., by James, of Exeter; by Murray, at the Cape of Good Hope; by Monteiro, at Rio Janeiro; and by South, of London.

In Sir A. Cooper's case, the inguinal aneurism had burst, and the vessel was tied about three quarters of an inch above its bifurcation, by making an incision three inches in length through the abdomen, a little to the left of the umbilicus, the fingers being passed between the convolutions of the intestines, and the peritoneum covering the artery being scratched through. The patient survived forty hours. James ligatured the aorta much in the same way as Sir A. Cooper did, in a case in which he had previously employed the distal operation for an inguinal aneurism; but without success, the patient speedily dying. Murray ligatured the vessel by making an incision on the left side, in front of the projecting end of the tenth rib, and carrying it downwards for six inches, to the anterior superior spine of the ilium. The parts were then carefully divided to the peritoneum, which was separated from the iliac fossa and the psoas muscle, when, with great difficulty, and

by scratching with the end of an elevator and the finger-nails, room was made for the passage of the ligature round the artery, which was tied three or four lines above its bifurcation. The patient died in twenty-three hours. The most interesting case on record is that by Monteiro, who tied the aorta for a large false aneurism on the lower and right side of the abdomen ; here the incision was made much as in Murray's case, and the artery ligatured with great difficulty. The patient lived till the tenth day, when he died of secondary hemorrhage. In South's case, the artery was tied behind the peritoneum by an incision on the left side of the abdomen. The patient died in forty-three hours.

In this operation, there are not only all the dangers attendant upon the ligature of arteries of the first magnitude, but also the risk of producing fatal peritonitis, whether the abdomen be cut through, or the vessel sought for by stripping up the peritoneum from the iliac fossa ; and it appears to me that a patient suffering from so large an inguinal aneurism as to justify ligature of the aorta, would have a better chance of recovery, or rather of prolongation of life, by the adoption of proper constitutional treatment, together with pressure upon the tumour and the distal ligature or compression of the artery.

ANEURISM OF THE INTERNAL ILIAC AND ITS BRANCHES.—Aneurism of the *Trunk of the Internal Iliac Artery* is extremely rare. The only case with which I am acquainted is one related by Sandifort. The three principal branches of this artery—the *Gluteal*, the *Sciatic*, and the *Pudic*—have all occasionally, though rarely, been found affected by this disease. Of these branches, the gluteal has been most frequently found aneurismal, the sciatic next, and the pudic least frequently ; indeed, I am acquainted with only one instance of aneurism of this vessel. It is the Preparation 1701 in the Museum of the College of Surgeons ; and it exhibits an aneurism of the trunk of the pudic, nearly an inch in diameter, full of fibrinous laminæ.

Aneurisms of the Gluteal and Sciatic Arteries may be either traumatic or spontaneous.

The symptoms of these aneurisms present nothing peculiar. A circumscribed pulsating tumour at the posterior part of the gluteal region, presenting the usual character of aneurism, would not in general leave much doubt as to the true nature of the case. In some instances, however, the diagnosis might not be quite so readily made out, as happened in a remarkable case in which Guthrie ligatured the common iliac artery for a large pulsating tumour in the gluteal region, which presented all the characters and signs of aneurism, but which proved, on the death of the patient eight months after the operation, to be a pure enccephaloid tumour.

LIGATURE OF THE INTERNAL ILIAC.—This vessel was ligatured for the first time in 1812. The operation was performed by Dr. Stevens of St. Croix, on a negress, who suffered from an aneurism of the nates, supposed to be of the gluteal artery, but found after her death three years subsequently to take its origin from the sciatic. Dr. Stevens in this case made an incision five inches long on the left side of the abdomen, carefully dissected through the parietes, separated the peritoneum from the iliac fossa, turned it on one side, together with the ureter, and passed a ligature round the artery without much difficulty. Since that time the operation has been done nine times ; in 4 cases with success, by Aremdt, White, Mott (who accidentally wounded the peritoneum), and Syme ; in 5 cases unsuccessfully, by Atkinson of York (whose patient died on the nineteenth day of secondary hemorrhage), by Altmüller, by Thomas, by J. K. Rodgers, and by Higginson.

The success that has hitherto attended this operation is certainly remark-

able, when we take into consideration the depth at which the artery is situated and its great size ; it must, I think, be accounted for by the fact that, although in these cases the patient runs the ordinary risks attendant on the ligature of the larger pelvic arteries from the exposure and handling of the peritoneum, yet he is saved the danger resulting from the supervention of gangrene ; the anastomosis between its branches and that of the neighbouring vessels being so free, and the course traversed by the blood so short, that no difficulty can arise in the maintenance of the collateral circulation.

The steps of the operation necessary for the exposure of the internal iliac artery are precisely analogous to those requisite for the ligature of the common trunk. When the vessel is reached, it must be remembered that both the external and the internal iliac veins are in close relation to it ; the one being to its outer side, the other behind it. As these vessels are large, and their coats thin, it is necessary that they should be separated by the finger-nail, or the blunt end of an aneurism-needle, before the ligature is passed round the artery ; care must also be taken not to put the vessel too much on the stretch in applying the ligature, lest the ilio-lumbar artery be ruptured. As the length of the artery varies much, usually ranging between one and two inches, and as when it is short it has a tendency to be placed deeply in the pelvis, it would, I think, be more prudent, and occasion less chance of secondary hemorrhage, for the surgeon, under such circumstances, to ligature the common trunk.

FEMORAL AND POPLITEAL ANEURISMS.

We have, in the preceding section, considered aneurisms affecting the groin, which are by no means of very unfrequent occurrence. Aneurisms of the thigh are, however, much less frequently met with ; but those in the ham are very commonly encountered. Thus, out of 551 cases of aneurism recorded in the British medical journals of the present century, Dr. Crisp has found that 137 affected the popliteal, and only 66 the femoral artery. Of these 66, 45 were situated either in the groin or upper part of the thigh, and 21 only were truly femoral, or femoro-popliteal. The reason of this difference in the frequency of the occurrence of aneurism in different parts of the vessel, may be accounted for by attention to its anatomical relations. In looking at the main artery of the lower extremity, in its course from Poupart's ligament to where it terminates in the interior and posterior tibials, we see that it may be divided in relation to the muscular masses that surround it, into three principal portions : 1. That which is situated between Poupart's ligament and the anterior margin of the sartorius, which may be considered *inguinal* ; 2. That which intervenes between this point and the aperture in the adductor tendon, which may be considered *femoral* ; and, 3. That division of the vessel which corresponds to the ham, and which may be considered *popliteal*. Of these three divisions, the first and last are comparatively superficial, and, being unsupported by muscle, readily expand ; while the central portion of the artery is closely surrounded on all sides by muscular masses, and is less likely to be dilated into an aneurismal tumour. We also find that the inguinal portion of the vessel is closely and firmly invested by a dense and resistant fibro-cellular sheath, and is well supported by the fascia lata ; whilst in the popliteal space the artery is merely surrounded by the ordinary cellular sheath, and receives no aponeurotic support. This difference in the connections of these two parts of the vessel may, to a certain extent, explain the greater frequency of aneurism in the ham than in the upper part of the thigh.

ANEURISM OF THE DEEP FEMORAL ARTERY is of extremely rare occur-

rence; indeed, I am acquainted with two cases only. One of these is recorded by Bryant as having occurred in the practice of Cock at Guy's Hospital. The aneurism was situated at the origin of the deep femoral artery; the external iliac was tied, but the patient died nine weeks after the operation. Fig. 211 is taken from a patient who died of pneumonia, under Dr. Garrod's care, very shortly after admission into the hospital. On examination after death, a large tumour of the thigh, which had not been very closely examined during life, proved to be a circumscribed aneurism of the deep femoral artery.

ANEURISMS OF THE SUPERFICIAL FEMORAL AND POPLITEAL ARTERIES.—These commonly occur about the middle period of life, and are almost invariably met with in males, being at least twenty times more frequent in them than in women. Both sides are affected with equal frequency, and occasionally at the same time. According to Crisp, sailors would appear to be more liable to this variety of the disease than any other class. These aneurisms are most frequently sacculated; in the ham they are always so, but in the thigh they are sometimes tubular.

SYMPTOMS.—The symptoms of *Femoral Aneurism* present nothing peculiar; the tumour usually enlarging with considerable rapidity, with all the characteristic signs of the disease, and assuming a pretty regular ovoid shape. *Popliteal Aneurism* usually commences with stiffness and a good deal of pain about the ham and knee, which I have more than once seen mistaken for rheumatism; there is also a difficulty in straightening the limb, which is generally kept semi-flexed. The tumour increases usually with great rapidity, and has a great tendency to become diffused; these conditions will, however, materially depend on the side of the artery from which it springs. When it arises from the anterior aspect, next the bone, it increases slowly, being compressed by the firm structures before it. In this case, however, there is the great danger that, by its pressure upon the bones and knee, it may give rise to caries and destruction of the joint. When it springs from the posterior part of the artery, where it is uncompressed, it increases rapidly, and may speedily diffuse itself. The diffusion of an aneurism in this situation may take place in two directions. If it be femoro-popliteal, it may give way into the general cellular tissue of the thigh, the blood diffusing itself as high perhaps as Scarpa's triangle. When it is confined to the ham, it may either give way under the integuments, and into the superficial structures of the limb, or else under the deep fascia of the leg, where it will compress the posterior tibial nerve and artery. In all cases, the diffusion of popliteal aneurism is likely to be followed by gangrene.

DIAGNOSIS.—The diagnosis of popliteal aneurism has to be made from chronic abscess, from bursal enlargements, and from solid tumours. In distinguishing it from chronic abscess, no serious difficulty can well be experienced; but it may happen that, when an aneurism has suppurated, considerable difficulty arises in determining its true nature; whether it be merely an abscess or not. On such cases as these the state of the circulation in the lower part of the limb will throw much light. *Bursal tumours*, often of large size and multilocular, are not unfrequently met with in the ham; but

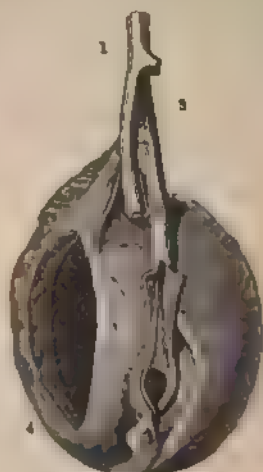


Fig. 211.—Aneurism of Deep Femoral Artery.

- 1 Common Femoral.
- 2 Superficial Femoral.
- 3 Deep Femoral. 4 Aneurism.

I have never found any great difficulty in determining their true nature, their elasticity and roundness, together with their mobility and want of pulsation, being sufficiently indicative of their character. The most serious diagnostic difficulty may arise from confounding solidified aneurisms of the ham with *solid tumours*, either of a sarcomatous character, or springing from the tibia and femur; and I have known one case of aneurism in this condition, in which amputation was performed on the supposition of its being a solid tumour (Fig. 191).

TREATMENT.—The treatment of femoral and popliteal aneurism may be conducted either by ligature, or by compression of the vessel leading to the sac. As a general rule, for the reasons already stated, compression should be employed in preference to the ligature; but yet cases may arise when, from the failure of compression, or for other reasons, it may be necessary to ligature the femoral artery.

LIGATURE OF THE COMMON FEMORAL.—In looking at the femoral artery, it might at first be supposed that the common trunk, situated superficially between the inferior edge of Poupart's ligament and the origin of the deep femoral, would be the most convenient situation for the application of the ligature; but experience has shown that deligation of the vessel here is in the highest degree unsuccessful. This arises from the shortness of the trunk, rendering it necessary to tie the artery between and in close proximity to those collateral branches that will constitute the most direct and immediate agents in the anastomosing supply,—viz., the circumflex ili and the deep femoral, so that the internal coagulum would not readily form. In addition to this, however, a number of small inguinal branches, such as the superficial epigastric and circumflex ili, the superficial and deep external pudic, and very commonly one of the circumflex arteries of the thigh, more especially the internal, arise from the common trunk in its short course, and these vessels, though small in size, constitute a source of great embarrassment to the surgeon during the operation, for, if wounded near their origin, they bleed most furiously, and are a cause of considerable danger afterwards, by interfering with the proper plugging of the vessel. Of twelve recorded cases, in which this artery has been tied, it would appear that three only succeeded; whilst in the remaining nine instances secondary hemorrhage occurred, which proved fatal in three, and in six was arrested by the ligature of the external iliac. This operation, I think, therefore, ought to be banished from surgery; and, in all those cases of aneurism that are situated above the middle of the thigh, and in which sufficient space does not intervene between the giving off of the deep femoral and the upper part of the sac for the application of a ligature to the superficial femoral, the external iliac should be tied, unless compression can be employed.

LIGATURE OF THE SUPERFICIAL FEMORAL.—The superficial femoral artery, in its course from the origin of the deep femoral to the aperture in the tendon of the adductor, is divided by the crossing of the sartorius muscle into two portions of unequal length, which have different relations to neighbouring structures. The upper division of the artery, which lies above the anterior margin of the muscle, is of most interest to the surgeon, as it is in this part of its course that it is invariably ligatured in cases of aneurism. It is true that John Hunter, in the operation which he introduced for popliteal aneurism, exposed and tied the vessel in the lower third of the thigh, but his example has not been followed by modern surgeons, on account of the far greater difficulty in reaching the vessel here than in the first part of its course.

The superficial femoral, where it lies in Scarpa's triangle, being merely covered by the common integument, the superficial fascia, and the fascia

lata, may be reached by as simple an operation as any that the surgeon has to perform for the ligature of the larger vessels. An incision, from three-and-a-half to four inches in length, should be made from a point two inches below Poupart's ligament, and as nearly as possible midway between the anterior superior spine of the ilium and the symphysis pubis, and carried downwards in a direction parallel to the axis of the limb. The skin and superficial fascia having been divided, the *fascia lata*, which is here very thin, is exposed and opened to the same extent as the incision in the integuments; the inner margin of the sartorius now comes into view, and immediately to the inner side of, and perhaps slightly overlapped by this, is the sheath of the vessels; this must now be cautiously opened, the long saphenous nerve being respected, and the aneurism-needle unarm'd passed between the artery and vein, from within outwards, about four inches below Poupart's ligament; it should then be threaded and withdrawn, and the ligature tied. The edges of the wound must now be brought into contact by a couple of stitches and two strips of plaster; the limb being semi-flexed, somewhat raised, laid on its outer side, and wrapped in soft flannel or cotton-wadding. The severe pain which is usually complained of about the knee after the tightening of the ligature, may best be relieved by a full dose of opium.

In this operation there are several points of considerable importance that require special attention. The ligature should always be applied about four inches below Poupart's ligament, so that sufficient space may intervene between the origin of the deep femoral, which is usually from one or two inches below the crural arch, and the point deligated, to admit of the formation of a proper coagulum in the vessel. It has, indeed, happened that the ligature has been placed within three-quarters of an inch of the origin of the deep femoral, without any injurious consequences resulting. The proper point, however, for the deligation of the artery is that indicated, which is usually the very spot at which the sartorius crosses it; though, if this muscle be very broad, it may be necessary to draw it to the outer side, and tie the vessel below it. In cutting down upon the artery, the saphenous vein, or any parallel branch, should if possible be avoided. After the sheath has been opened, it will sometimes be found that a rather large muscular branch is given off from the artery at about the part where it was intended to ligature it; if so, this must be carefully avoided, as well as any small veins that cross the main trunk in this situation.

The femoral vein, which lies behind and somewhat to the inner side of the artery, is best avoided by passing the needle from within outwards between the two vessels; the inner side of the sheath being at the same time put upon the stretch by drawing upon it with a pair of forceps. After the needle has been brought up on the outer side of the artery, a small portion of the sheath will sometimes be found to be pushed up by it; this must be divided by being carefully touched with the point of the scalpel, when the needle may be carried round the vessel.

Results — Ligature of the femoral artery for popliteal aneurism is an operation that has been so frequently performed, that surgeons seldom think of recording cases of this description, unless they present complications or sequelae of unusual interest or severity; hence but little importance can be attached to any statistical deductions from reported cases as to the fatality of the operation, although they may serve as a rough estimate of the proportion maintained between the different accidents, such as hemorrhage, gangrene, &c., that follow it. That the ligature of the femoral artery is attended with more success than that of any of the other large trunks, can admit of no doubt. This is not only in accordance with the general experience of

surgeons, but is confirmed by the statistics of published cases, even without making allowance for the probability of more of the unsuccessful than successful having been recorded. Thus of 110 instances, collected by Dr. Crisp, in which the femoral artery had been ligatured for popliteal aneurism, only twelve are reported to have died; amongst these, four deaths occurred by secondary hemorrhage, three by gangrene, and the others by phlebitis, tetanus, chest-disease, &c. Higher rates of mortality are, however, given by other authors; thus, Norris states that nearly one in four die after this operation; Hutchinson finds that of thirty-three cases operated on in London, ten were fatal, five deaths resulting from gangrene.

ACCIDENTS.—*Wound of the Femoral Vein* is without doubt the most serious accident that can happen in the operation for ligature of the superficial femoral artery, and is one of which there is especial risk when recourse is had to this operation for aneurism; as in this disease the fine cellular tissue which naturally connects the two vessels often becomes thickened and indurated, in consequence of inflammatory action having extended upwards from the sac to the sheath of the vessels. It is best avoided by passing the needle in the way that has been already recommended, unarmed, and without the employment of force. This accident is almost invariably fatal, there being but very few instances on record in which patients have survived it; death usually resulting from diffuse phlebitis, or the superintention of gangrene. The true cause of the fatal result in these cases was first pointed out by Halwen, who showed that, when the vein is wounded by the aneurismal needle, it is transfixated at two points, between which the thread is drawn across; and when this is tied, a segment of the vein is necessarily included with the artery in the noose. It is this inclusion of the ligature within a portion of the vein, where it acts like a seton, and keeps up constant irritation, that prevents the occurrence of adhesive phlebitis, and occasions diffuse inflammation in the interior of the vessel; and it is consequently this circumstance, and not the mere wound of the vein, that determines the great fatality of this peculiar accident. Guided by this view of the mechanism of the injury, the indications in its treatment become obvious. They consist in removing the ligature at once, and thus, by taking away the main source of irritation, converting the wound into a simple puncture of the vessel, which readily assumes adhesive action. The surgeon should, therefore, as soon as the accident is perceived, withdraw the ligature, and, opening the sheath about half-an-inch higher up, re-apply it to the artery there. The hemorrhage from the punctured vein readily ceases on the application of a compress.

The occurrence of *Secondary Hemorrhage* after the ligature of the superficial femoral is a troublesome accident, and one in which the surgeon, to use Fergusson's expression, "will most assuredly find himself in an eventful dilemma;" and in which it is necessary that his line of action should have been well considered beforehand, as he may not have much time to spare for reflection when such an event takes place. In cases of this kind four lines of treatment present themselves, viz.: the employment of pressure; ligature of the vessel at a higher point; deligation of the bleeding apertures in the wound; or amputation of the limb.

Pressure may be applied by placing a graduated compress of lint or compressed sponge over the bleeding orifices, and fixing it there firmly by a horse-shoe tourniquet. This means, although extremely uncertain, occasionally succeeds; should it not do so, however, and bleeding recur a second time, it is useless to continue it, as experience has shown that the hemorrhage will continue until the patient is worn out.

Location of the superficial femoral at a higher point, or, if the artery have been cut too high for this, the deligation of the external iliac, presents itself as a probable means of arresting the hemorrhage. Such an operation, however, is fraught with danger, and has, I believe, invariably been followed by gangrene of the limb. It might at first be supposed that the limb would not be placed in a worse situation after the ligature of the external iliac, whether the superficial femoral had been previously tied or not; the anastomosing channels remaining the same in either case. But in reality it is not so, for, although the blood might find its way through the epigastric, the circumflex ilii, the gluteal and sciatic arteries, into the deep femoral and its branches, yet from this point the difficulty of its transmission through the trunk would be materially increased. If the superficial femoral be open, it serves as a direct and easy channel for the conveyance, to the vessels of the leg and foot, of the blood brought by the anastomoses. But when the superficial femoral is tied, this blood must find its way through a second chain of anastomosing vessels,—those intervening between the branches of the deep femoral and the articular arteries of the knee; and here the real difficulty would arise, its impulse not being sufficient to overcome the obstruction to its passage through these small channels, which might not probably be still further obstructed by the pressure of the aneurism. Should the anastomosing circulation be sufficiently free to maintain the vitality of the limb, it is not improbable that the recurrent blood would escape from the distal side of the ligature, and thus keep up the hemorrhage exactly as in case of wound. It appears indeed that the femoral artery, in a case of secondary hemorrhage after the application of the ligature, is in very much the same condition as an artery which has been wounded, and in which the bleeding, having been suppressed for some days, has returned with violence; and I think the best course for the surgeon to pursue is the same practice that he would follow in the event of secondary hemorrhage occurring from a wounded vessel, viz., by cutting down upon the bleeding part and applying a ligature to it. That such an operation is surrounded with difficulties cannot be doubted; yet none would present themselves that care and skill might not overcome. The surgeon would certainly have to cut into a part infiltrated with blood, in which the different tissues could not readily be distinguished, and the vessel when reached would be found to be soft, friable, and granulating, yet by free dissection above and below the wound, a portion of it might at last be exposed, where its coats would hold a ligature; or should this not be found, the wound might be firmly plugged from the bottom with compressed sponge; or the bleeding aperture might be touched with the actual cautery. Should these means fail, it would, I think, be safer to amputate the limb, than to endeavour to arrest the hemorrhage in any other way.

Gangrene of the Limb is perhaps the most frequent source of danger after ligature of the femoral artery for popliteal aneurism. It seldom occurs, however, unless the tumour be of considerable magnitude, have become disorganised, or otherwise interfere seriously with the circulation through the limb. I have, however, seen it follow the operation where the popliteal aneurism had not attained a larger size than that of an orange; but, in this case, there was much œdema of the limb, and congestion of the veins before the operation; and on examination afterwards, it was found that the popliteal vein had been obliterated by the pressure of the tumour. The gangrene may, in some cases, be prevented by the treatment that has been pointed out at page 185. When it has fairly declared itself, there is necessarily no resource left but amputation, and this operation is sufficiently successful; for

I find that of fourteen cases in which it was done, there were ten recoveries, and but four deaths.

The *Return of Pulsation in the Sac* after the operation for popliteal aneurism is by no means of frequent occurrence; yet it has been met with in some instances, and *Secondary Aneurism* has also been found in this situation. In these cases the patient should be put upon a careful dietetic plan, the limb be kept elevated and at rest, and pressure applied by means of a compress and bandage, or a horse-shoe tourniquet. In this way cures have been effected by Wishart, Turner, Briggs, and Liston. In conjunction with such treatment, or in the event of its not sufficing, the compression of the common femoral artery as it passes over the pubic bone would in all probability effect a cure. Should it not do so, and the tumour continue to increase, threaten to suppurate, or to occasion gangrene, amputation would be the sole resource.

DOUBLE POPLITEAL ANEURISM.—In cases of this kind the artery has been occasionally ligatured with advantage on both sides, either simultaneously, or, with more safety, consecutively. But these cases appear to me especially adapted for the employment of pressure, so as to avoid that disturbance of the balance of the circulation which is certain to ensue when one vessel is ligatured, and which may act injuriously upon the opposite aneurism. When the popliteal aneurism is conjoined with a similar disease in the groin, ligature of the external iliac is the proper course to pursue, and will effect a cure of both affections.

DIFFUSE POPLITEAL ANEURISM.—When a *circumscribed* popliteal aneurism suddenly becomes *diffused*, the patient is seized with faintness or sickness, with pain, numbness, and a hot trickling sensation in the limb, the temperature of which falls at the same time that its bulk increases, and the integument assumes a white, shining, mottled appearance, with more or less purplish discoloration. This condition usually occurs after a circumscribed aneurism has existed in the ham for some weeks or months, and on the occurrence of some sudden exertion. In some cases, however, the disease appears to have been diffused from the very first, the coats having given way, and extravasation having taken place into the cellular tissue of the limb, without the previous consolidation of the parts around the artery, or any attempt at the formation of a sac. In these cases the extravasation into the limb may either be conjoined with much œdema; or it may be confined to the cellular tissue of the ham, and to the upper and back part of the leg, or extend downwards under the muscles of the calf. When the patient comes under the observation of the surgeon, the tumour is found to be solid, elastic, and irregular, without pulsation or bruit; the limb œdematous, cold, and congested. The diagnosis of this form of aneurism is often extremely difficult, and there is great danger of confounding it with simple extravasation into the calf, with abscess, or, possibly, with malignant tumour of the leg.

Treatment.—The danger attending on popliteal aneurism is greatly increased by its becoming diffused. Under these circumstances the ligature of the artery usually affords but a slender prospect of success, the collateral vessels being so compressed and choked by the pressure of the effused blood as not to admit of the circulation being carried on through them; hence, in many of these cases, the only resource left to the surgeon is to amputate the limb.

AMPUTATION FOR DIFFUSE POPLITEAL ANEURISM.—The question of *Amputation* in cases of diffuse popliteal aneurism is not very easily submitted to any very positive or definite rules, except where the independ-

ing gangrene is so evident as not to admit of doubt. There are, however, certain general considerations that may guide the surgeon in deciding on this point.

1. In some cases the sac has either given way to a very limited extent ; or else its walls, having become thin and expanded, are yielding rapidly under the pressure of the blood, becoming confused with the surrounding parts. Here we should ligature the artery without delay ; for although it is but seldom that a limb can be saved when once the blood has become infiltrated into the general cellular tissue, yet it is possible that such a fortunate occurrence may happen.

2. In other instances the aneurism has not from the first been very distinctly circumscribed. It has followed the infliction of some mechanical injury, and in the course of a week or two has acquired a considerable size, without definite or distinct limitation, being solid or but little compressible. Such a case as this can scarcely be considered, strictly speaking, a diffuse aneurism ; but yet, if by *circumscribed* we mean that the blood is contained in a defined cyst with walls, it scarcely complies with such a definition, the fluid blood being rather prevented from escaping widely by a temporary barrier of coagula entangled in the loose cellular tissues of the part, and the vessel being ruptured to a considerable extent, or completely torn across. Here we are certainly justified in having recourse to compression or ligature with a good prospect of success.

3. When the ham is occupied by a large, rapidly increasing tumour, extending perhaps some way down the calf and up the thigh, and encroaching on the knee, the skin covering it being more or less discoloured, there being no pulsation perceptible in the tibial arteries, and the veins of the limb being full and even somewhat congested, the foot oedematous and several degrees in temperature below that of the opposite limb, the difficulty of coming to a decision is considerable.

In such a case as this, I think that the existence or non-existence of pulsation of a distensible character is a circumstance of very great importance, and may serve to guide the surgeon.

If there be distinct impulse of a distending character, which can be arrested by compression of the femoral artery, with some diminution of the size of the tumour, it is an evident indication that blood is being transmitted through the sac, and that this contains some fluid blood. Under these circumstances it will, when the artery is tied, subside to a considerable extent, thus allowing more space for the conveyance of the collateral circulation ; and it would be but right to give the patient the chance of preserving his limb by ligaturing the vessel.

If, however, the tumour have, from the very first time when it attracted the patient's notice, been more or less solid and incompressible ; and, though it may at an early period of its existence have pulsed, if this pulsation have suddenly ceased, the aneurism at the same time having undergone rapid and great increase of bulk with much tension and lividity of the integuments, oedema and coldness of the limb, with a tendency perhaps to vesication and ulceration of the skin covering the tumour, there is no resource left but amputation.

It must however be borne in mind, that the aneurism may become diffused, and extensively so, without any very great change in the shape and size of the limb. It is only when the sac ruptures in such a position that the blood is effused into the general cellular tissue of the limb or under the skin, that much tension of the integuments and increase in the bulk of the part takes place.

4. When a rupture occurs in a part of the sac that is more deeply seated, the blood is extravasated underneath the deep fascia of the leg, and is bound down by this and by the superincumbent muscles; and disorganisation of the interior of the limb may be the result, without much, if any, change in its bulk or in the colour of the integuments, but with excessive deeply seated pain. There must always be considerable risk, in such a case as this, of confounding the arterial disease with solid tumour; and the diagnosis can be effected only by a reference to the early history of the case, and more particularly to the existence or absence of pulsation at this period. Indeed, the existence or non-existence of pulsation in these cases, is of the very utmost importance in reference to the question of treatment. The pulsation may have ceased in a case of diffuse popliteal aneurism, in consequence of the blood that has been extravasated being so confined and bound down by the fascia and muscles under which it is effused, that it compresses or seals the mouth of the artery leading into the sac, to such an extent as to arrest the passage of blood through it, either wholly or so that it enters in a feeble stream, of insufficient force to communicate impulse to the fluid that has been extravasated into the limb. This pressure may, as in the case of which an illustration has been given (Fig. 191), be confined to the deep parts of the limb and not give rise to much, if any, general tension of it, the blood being confined below the deep fascia, where it communicates the sensation of a hard solid elastic tumour devoid of pulsation; attention should consequently not be too exclusively directed to the state of general tension of the surface of a limb, as this is by no means necessarily an indication of the state of the parts beneath. But the surgeon should rather look to the presence or absence of pulsation. If pulsation still exist, the blood continues to find its way into the sac, and most probably through it, the tension of the parts not having yet reached its maximum. If there be no pulsation, he may be sure that the entrance of blood into the diffused aneurism has ceased in consequence of compression exercised on the mouth of the artery leading to it, by the tense condition of the surrounding and enveloping tissues re-acting on the mass of blood effused beneath them. In such a state of things as this, the vitality of the lower part of the limb can only be maintained by the blood that may find its way through the anastomosing channels; and this may, if the tension of the limb be not general, the extravasation being confined below the deep fascia, be sufficient for this purpose. If surgical interference be delayed in such a case as this, the deep fascia will soon give way by rupture or ulceration, and the blood will be infiltrated into the general cellular tissue of the limb; and then, by compressing those collateral branches that have hitherto maintained a feeble circulation in it, will infallibly occasion gangrene. If, on the other hand, ligature of the main artery be had recourse to, the anastomosing circulation, which may have been barely sufficient to keep up a feeble vitality in the leg and foot, will be so much interfered with that gangrene of the limb inevitably ensues. The only resource, therefore, that is left in these cases is to amputate at once, in order that the patient may be saved the shock of the constitutional disturbance occasioned by the setting in of mortification, as well as the pain and risk of a previous unnecessary operation.

5. When gangrene threatens, the leg and foot having become cold, the skin being either pale, tallowy and mottled, or discoloured, of a purplish hue, with perhaps vesications and much cedema, whether the ligature have been previously applied to the femoral artery or not, or whatever the condition of the aneurism may be, whether circumscribed or diffused, the patient will stand a better chance of ultimate recovery by having the limb removed at

once above the knee. The part at which amputation should be performed in these cases is a point deserving some consideration. If the femoral artery have been ligatured, the thigh should be amputated on a level with the ligature, the artery being cut just above this. In this way the double risk which the patient would otherwise run of secondary hemorrhage from the seat of the ligature, as well as from the face of the stump, will be reduced to a single chance of hemorrhage from the stump. If the amputation be the primary operation, it should be done at the lower third of the thigh, provided the extravasation be confined to below the knee; or higher up, if the effused blood have extended above this joint.

ANEURISM OF THE TIBIAL ARTERIES.

Aneurisms of the Tibial Arteries are extremely rare, except as the result of wound, yet they are occasionally met with; and in the museum of St. George's Hospital is a preparation of a small aneurism of the posterior tibial. These aneurisms sometimes, however, require ligature either for injury or for disease.

LIGATURE OF THE TIBIAL ARTERIES.—The *Posterior Tibial Artery* may be tied in two parts of its course; either behind the ankle, or in the calf of the leg. Behind the ankle, it may be reached by making a semilunar incision three inches long, about three-quarters of an inch behind the inner malleolus, towards which its concavity should look. After dividing the integument and superficial fascia, the deep fascia, which is usually single, but may be double, must be laid open; this closely invests the vessel, nerve, and tendons in this situation; under it the artery will be found accompanied by two veins, from which it must be separated before the ligature is passed. Anterior to the vessel, and nearer the bone, are the tendons of the flexor digitorum communis and tibialis posticus muscles; behind, are the nerve and the tendon of the flexor proprius pollicis.

In the middle of the leg, the posterior tibial artery should be tied only for wound in that situation. Under such circumstances no regular operation can be performed, but an incision of sufficient length, taking the wound for its centre, should be made through the gastrocnemius and soleus, parallel to their fibres, when, after these have been cut through, the deep fascia will be exposed. This must next be opened, when the artery will be found, accompanied by its veins, and having the nerve to the outer side. From the depth at which the vessel is situated, and the free incisions that it is necessary to make through muscular parts, it is extremely difficult to apply the ligature in this situation. The later steps of the operation may be much facilitated by flexing the leg on the thigh, and extending the foot so as to relax the muscles.

The *Anterior Tibial Artery* may be tied in several situations; but, like the posterior tibial, it should not be ligatured in the upper or middle parts of the leg, except for injury. The difficulties of the operation are lessened as the ankle is approached, where the artery becomes superficial, and may easily be secured.

In the upper third of the leg the artery lies deeply between the tibialis anticus and extensor communis digitorum muscles, surrounded by veins, and having its nerve to the outside. If it be ever found necessary to tie it in this situation, the incisions requisite to expose it should be made at least four or five inches in length; and especial care should be taken not to cut into the muscular substance, but to open the first intermuscular space to the outside of the tibia, at the bottom of which the vessel will be found. In the middle third of the leg, the artery is crossed by the

extensor pollicis, and will be found between the tibialis anticus and this muscle; it is best reached here by keeping well to the outside of the tibialis anticus.

The *Arteria Dorsalis Pedis* may be felt pulsating, and may readily be secured, as it runs forward from the ankle-joint to reach the space between the first and second metatarsal bones, lying between the tendon of the extensor pollicis and that of the extensor brevis digitorum.

CHAPTER XLIV.

ANEURISM BY ANASTOMOSIS, AND NÆVUS.

ANEURISM BY ANASTOMOSIS.

Aneurism by Anastomosis is a disease of the arteries, in which the vessels become excessively elongated, tortuous, and serpentine; sometimes they assume a varicose condition, being dilated into small sinuses, and are always very thin-walled, resembling rather veins than arteries in structure. This kind of dilatation of the vessels will give rise to pulsating tumours, often of considerable size, and of a very active and dangerous character. They may be situated in almost any tissue or organ of the body, but are most commonly met with in the submucous and subcutaneous cellular tissue, and most frequently occur in the upper part of the body, especially about the scalp, orbit, lips, and face; but they have been met with in other situations, such as the tongue, and even in internal organs, as the liver; and I have seen very active growths of this kind on the uates and foot. In some cases, aneurism by anastomosis occurs in bones, in which it forms a special disease, and is not uncommonly associated with encephaloid. Indeed, there is certainly a great tendency for aneurism by anastomosis and encephaloid to run into one another; the limits between them not being very clearly defined, especially when they occur in connection with osseous tissue. It will generally be found that the arteries leading to, though at a considerable distance from the aneurism by anastomosis, are tortuous, enlarged, with thin and expanded coats, and pulsate actively; in fact, constituting that condition that goes by the name of *Circoid Dilatation* of the vessels.

Aneurism by anastomosis forms tumours of varying magnitude and irregular shape; they are usually of a bluish colour, have a spongy feel, are readily compressible, not circumscribed, and have large tortuous vessels running into and from them on different sides. Their temperature is generally above that of neighbouring parts; and a vibratory or purring thrill, amounting in many cases to distinct pulsation, may be felt in them. This pulsation or thrill is asynchronous with the heart's beat, may be arrested by compressing the tumour or arteries leading to it, and returns with an expansive beat on the removal of the pressure. The bruit is often loud and harsh, but at other times of a soft and blowing character. These growths rarely occur in infancy, but generally make their appearance in young adults, though they may be met with at all periods of life, often as the consequence of an injury of some kind.

DIAGNOSIS.—It is of importance to effect the diagnosis between *ordinary aneurism* and that by anastomosis. In many cases the situation of the tumour at a distance from any large trunk, as on the scalp, the outside of

the thigh, or the gluteal region, will determine this. Then, again, the outline of the growth is less distinct than in true aneurism; and tortuous vessels will be felt leading to it from different directions. The swelling also is doughy, and very compressible; but when the pressure is removed, the blood enters it with a whiz and thrill, not with the distinct pulsating stroke that is found in aneurism. The pulsation, not so forcible as in aneurism, is more heaving and expansive. The bruit is louder, more superficial, sometimes having a cooing note. By pressure on the arteries leading to the tumour, these signs are usually not entirely arrested, though diminished in force, the blood entering it from the neighbouring parts, and in a less direct way.

TREATMENT.—The treatment of aneurism by anastomosis must depend upon the size and situation of the growth. When it is so placed that it can be *ligatured* or *excised*, as on the lip, or when of small size, about the neck, face, or scalp, it should be removed in one or other of these ways. I always prefer, in cases of *nævus*, the ligature, applied as will immediately be described, as being the safest, and upon the whole the readiest mode of getting rid of such a tumour. If excision be practised, it is necessary to be very careful to cut widely of the disease; if it be cut into, fearful hemorrhage may ensue, which can only be arrested by pressure, and which in several instances has proved fatal.

If the disease be very large and extended, as is commonly seen on the scalp, or if deeply seated, as in the orbit, neither ligature nor excision of the tumour can be practised, and it becomes necessary to starve it by cutting off its supply of blood. This may be done either by *ligaturing the principal branches leading to it, or the main trunk of the limb or part.*

Simple ligature of the arterial branches leading to the tumour has never, I believe, been followed by success; at least, in ten recorded instances in which it has been had recourse to, the disease has not in one instance been cured. It has, however, been successfully conjoined by Dr. Gibson in two cases of aneurism by anastomosis of the scalp, with incisions made round the tumour at intervals between the principal feeding arteries, which at the same time were tied.

The *main trunk* leading to the tumour has been ligatured in a considerable number of cases. The brachial and femoral arteries have been tied for disease of this kind situated on the extremities, and in some instances with success; but the carotid is the vessel that has been most frequently deligated, in consequence of the tumour being so commonly situated on the scalp and in the orbit. This operation has been done in twenty recorded cases, and in five instances both the carotids were ligatured at intervals of several weeks. In all of those cases in which the double operation was performed, the patients ultimately recovered. In some of the cases in which one carotid alone was tied, the disease, being seated upon the scalp, was not cured; and it was afterwards found necessary to have recourse to ligature of the tumour, to excision, and to other means of removal; indeed, when seated upon the scalp, this disease appears to be more intractable than in any other part of the body, owing probably to the freedom of the arterial supply from the numerous vessels that ramify in this region. Here, however, much benefit might be derived after ligature of the carotid, by adopting the plan suggested by Dr. Gibson of tying the feeding arteries, and making incisions between them down to the bone. The ligature of the carotid has answered best for diseases of this kind in the orbit; of thirteen instances in which the artery has been tied for aneurism by anastomosis in this situation, a cure was accomplished in the majority.

NÆVUS.

This disease, under which are included those various affections termed *Mother's Marks*, *Erectile Tumours*, and *Vascular Growths*, constitute an important and interesting section of surgical affections. It appears to consist essentially in an excessive development of the vascular tissue of a part, and differs greatly as to nature, cause, and treatment; according as the arterial, the capillary, or the venous elements of the tissue predominate. The predominance of the arterial tissue we have already considered, under the head of Aneurism by Anastomosis; it now remains for us to describe the Capillary and Venous Nævi.

CAPILLARY NÆVI appear as slightly elevated but flat spots on the skin, of a bright red or purplish tint, and having occasionally granular or papulated elevations, with some larger vessels ramifying on their surface. They often spread superficially to a considerable extent; they are usually situated on the face, head, neck, or arms, but occasionally, though more rarely, on the back, the nates, the organs of generation, and the lower extremities; they are, I believe, always congenital, though often at birth of a very small size, not larger than a pin's head, from which they may spread in the course of a few weeks or months to patches an inch or two in diameter. In many cases no inconvenience results from this disease except the deformity it entails; but occasionally, more especially when the growth is at all prominent, there is a great disposition to ulceration of an unhealthy and hemorrhagic character. When bleeding occurs, it is usually in a trickling stream, and without any degree of force.

VENOUS NÆVI are of a dark purple or reddish colour, usually very prominent, and often forming distinct tumours of considerable size, which may either be smooth and ovoid, or else somewhat lobulated. On compressing a growth of this kind, it subsides to a certain extent, feeling doughy, soft, and inelastic, and on the removal of the pressure fills up again. In some cases, when consolidated by inflammation, or containing cysts, it cannot be lessened in bulk by pressure. These nævi are usually of about the size of half a walnut, but sometimes much larger. I have removed them from the nates and the back fully as large as an orange. They less frequently occur upon the head and face than the capillary form of the disease; most of the instances that I have seen have been met with in the lower part of the body, about the nates, back, lower extremities, and organs of generation.

Subcutaneous nævi are occasionally met with, of a mixed character, forming soft, doughy, and compressible tumours, which may be recognised by being capable of diminution by pressure, on the removal of which they slowly fill out again to as large a size as before; they also become distended when the child screams or struggles, and are usually of an oval shape, smooth and uniform. The skin covering the tumour is often unaffected; at other times it is implicated in an oval patch on the most prominent part of the growth, and occasionally the surrounding veins are bluish and enlarged.

STRUCTURE.—Capillary nævi appear to be composed of a congeries of small tortuous vessels, of a capillary character; venous nævi appear made up of thin tortuous veins, dilated into sinusses and small pouches. In the midst of these sinusses, cysts are not uncommonly found, sometimes containing clear, at other times a dark, sanguinolent fluid. These cysts are probably venous sinusses, the openings into which have become occluded.

TREATMENT.—In the treatment of nævus, the first point to be determined

is whether the case should be left to nature, or whether operative measures should be had recourse to. In deciding this point we must be guided by the size, situation, and character of the morbid growth. If this be small, cutaneous, and superficial, so situated that it occasions little or no disfigurement, and if it show no tendency to increase, it may be left without interference; when it may eventually shrivel and disappear, or become converted into a kind of mole. In some cases this process may be hastened by the application of tincture of iodine or liquor plumbi. In other cases, again, the nævus, though cutaneous and superficial, is so widely diffused over the surface, that no attempt at its removal or destruction can be entertained with prudence.

But if the nævus be large, if it be subcutaneous, or if it increase in size, or if it be so situated as to occasion disfigurement, then means must be adopted for its removal by operative procedure.

Operations for the removal of nævi may be conducted on four principles:—1, to excite adhesive inflammation in them, and so to produce plugging and obliteration of the vascular tissue of which they are composed; 2, to destroy the growth by caustics; 3, to remove it with the knife; or, 4, to remove it by ligature. Each of these different plans of treatment is peculiarly applicable when the disease assumes certain forms, and affects certain situations.

1. When the nævus is of small size, and occurs in such situations that its destruction by caustics, or removal by knife or ligature, would be attended by serious deformity, as when it is seated about the eyelids, upon the tip of the nose, at the inner angle between the eye and the nose, or about the corners of the mouth, it is best to endeavour to procure its obliteration, by exciting adhesive inflammation in it. This may be done in various ways. If small, the nævus may be vaccinated. If it be larger, the most convenient plan consists, perhaps, in passing a number of fine silk threads across the tumour in different directions, and leaving them in for a week or two at a time, until they have produced sufficient inflammation along their tracks, then withdrawing them, and passing them into other parts of the tumour. In this way its consolidation may gradually be effected. Another very useful plan is to break up the substance of the growth subcutaneously, by means of a cataract-needle, or tenotome, and in the intervals between the different introductions of this instrument to keep up pressure upon it. In other cases, again, the requisite amount of consolidation will be induced by passing acupuncture-needles into the nævus, and then heating them by means of a spirit-lamp, or by injecting the perchloride of iron into it by means of a small glass syringe with a screw-piston rod and a fine sharply-pointed nozzle (Fig. 212). In all these different ways the surgeon may succeed in curing the disease.



Fig 212.—Syringe for Injecting Nævus.

2. When the nævus is small, very superficial, of the capillary character, with an exceedingly thin covering of cuticle, and so situated, as upon the arm, neck, or back, that a moderate amount of scarring is of little consequence, it may most conveniently be removed by the free application of nitric acid. This should be well rubbed on by means of a piece of stick; and, after the separation of the slough produced by it, its application must

be repeated as often as there is any appearance of the granulations springing up, which will occasionally happen at one angle of the wound, and is indicative of a recurrence of the vascular growth.

3. When the nevus is of large size, constituting a more or less distinct tumour, and is of a somewhat venous character, it may occasionally be excised. In doing this, however, care should be taken to cut wide of the disease; and no operation with the knife should be undertaken unless the growth be either so situated, as upon the lip, that the parts may readily be brought or compressed together, or upon the nates or thigh, and of a very indolent and venous character. It is especially when the nevus is of the lipomatous or cystoid character, that excision may be advantageously practised.

4. As a general rule, it is far safer and more convenient to extirpate the growth with the *ligature*; and this, indeed, is the mode of treatment that is most generally applicable to tumours of this kind in whatever situations they may occur, as it effectually removes them without risk of hemorrhage, and leaves a sore that very readily cicatrises.

The ligature requires to be applied in different ways, according to the size and situation of the tumour. In all cases, the best material is firm, round, compressed whip-cord. This should be tied as tightly as possible, and knotted securely, so that there may be no chance of any part of the tumour escaping complete and immediate strangulation. It is well, if possible, not to include in the noose any healthy skin, but to snip across with a pair of scissors, that portion of integument which intervenes between the cords that are tied together; at the same time, care must be taken to pass the ligatures well beyond the limits of the disease.

When the tumour is small, an ordinary double ligature may be passed across its base, by means of a common suture-needle; and, the noose being cut and the thread tied on either side, strangulation will be effected. When it is of larger size, and of round shape, the most convenient plan of strangulating the tumour is that recommended by Liston. It consists in passing, by means of long nevus-needles, fixed in wooden handles, and having the eye near their points, a double whipcord ligature, in opposite directions across the tumour; then cutting through either noose, and tying together

the contiguous ends of the ligature until the whole of the growth is encircled and strangled by them. In doing this, a few precautions are necessary: thus, the first nevus-needle should be passed across the tumour unarmed (Fig. 213, a), and used to raise up the growth somewhat from the subjacent parts. The second needle, armed (Fig. 213, b) as represented in the woodcut, carrying the whipcord ligature by means of a piece of suture-silk, should be passed across the tumour in the opposite direction to, but

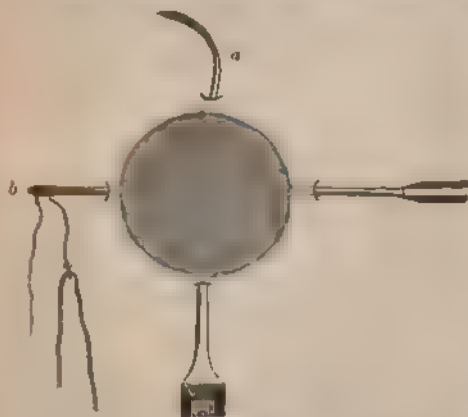


Fig. 213.—Application of Nevus needles.

underneath the first needle; the needle (b) being withdrawn, the ligature

is carried across; and, the first one having been armed in the same way, carries its noose through the tumour as it is drawn out. The two nooses having then been out, an assistant must seize, but not draw upon, six of the ligature ends; the surgeon then having divided the intervening bridge of skin, ties pretty tightly, in a reef-knot, the two ends that are left hanging out; as soon as he has done this, he proceeds to the next two, and so on to the last (Fig. 214). When he ties these, he must do so with all his force, especially if the tumour be large, as by drawing on them he tightens all the other nooses, and draws the knots towards the centre of the growth, which is thus effectually strangled. He then cuts off the tails of the ligature. After the tumour has sloughed away, which happens in a few days, if properly and tightly strangled, the sore is treated on ordinary principles. If the nævus be altogether subcutaneous, the skin covering it should not be sacrificed, but, being divided by a crucial incision, may be turned down in four flaps, and the ligature then tied as directed.



Fig. 214.—Nævus tied.

In some cases, the nævus is so flat and elongated that the application of the quadruple ligature, as above described, cannot include the whole of it. Under these circumstances, I have found the ligature about to be described eminently useful, having successfully employed it in a great number of instances. Its great advantage is that, while it completely and very readily strangles the tumour, it does not inclose an undue quantity of integument, and thus does not produce a larger cicatrix than is necessary for the eradication of the disease. It is applied in the following way. A long triangular needle is threaded on the middle of a whip-cord about three yards in length; one half of this is stained black with ink, the other half is left uncoloured. The needle is inserted through a fold of the sound skin, about a quarter of an inch from one end of the tumour, and transversely to the axis of the same. It is then carried through, until a double tail, at least six inches in length, is left hanging from the point at which it entered; it is next carried across the base of the tumour, entering and passing out beyond its lateral limits, so as to leave a series of double loops, about nine inches in length on each side (Fig. 215). Every one of these loops should be made about three-

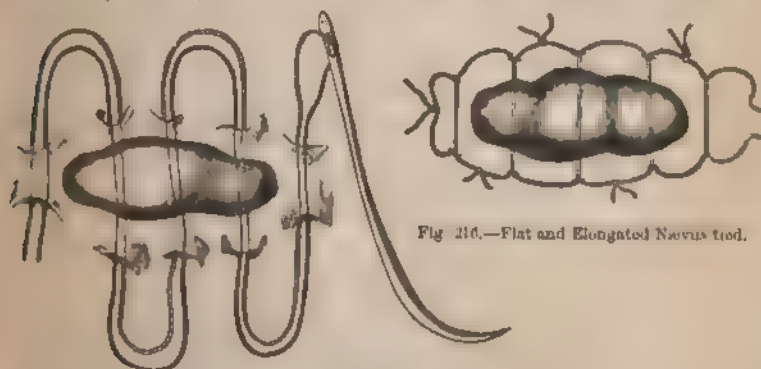


Fig. 216.—Flat and Elongated Nævus tied.

Fig. 215.—Ligature of Flat and Elongated Nævus.

quarters of an inch apart, including that space of the tumour; and the last loop should be brought out through a fold of healthy integument beyond

the tumour. In this way we have a series of double loops, one *white*, and the other *black*, on each side (Fig. 216). All the *white* loops should now be cut on one side, and the *black* loops on the other, leaving hanging ends of thread of corresponding colours.

The tumour may now be strangulated by drawing down and knotting firmly each pair of *white* threads on one side, and each pair of *black* ones on the other. In this way the tumour is divided into segments, each of which is strangulated, by a noose and a knot: by *black* nooses and *white* knots on one side, by *white* nooses and *black* knots on the other (Fig. 216).

The cicatrix resulting from the removal of a *nævus* is usually firm and healthy; but in some instances, I have seen it degenerate into a hard warty mass requiring subsequent excision. The ligature may be used successfully at all ages. I have repeatedly tied large active *nævi* in infants a month or two old, without meeting with any accident.

NÆVI IN SPECIAL SITUATIONS.—*Nævi* of the *Scalp* are more frequent than in any other situation, except, perhaps, the face. When occurring on those parts that are covered by hair, they are almost invariably prominent and subcutaneous; when seated on the forehead, or on the bare skin behind the ears, they are often cutaneous. The ordinary subcutaneous *nævus* of the scalp is readily removed by the application of the *quadruple ligature*. In general, it is better not to attempt the preservation of any of the integument covering the growth. It is true that, when removed, a clean white cicatrix is left which never covers itself with hair; but this contracts, and in after-life becomes but little visible. The attempt to dissect down the skin that covers the *nævus* is not only troublesome, but is attended by a very considerable, and possibly a dangerous amount of hemorrhage. Those flat *nævi* that are situated behind the ear are best treated by the free application of fuming nitric acid.

Nævus of the *Fontanelle* is the most important variety of the scalp-*nævus*, and constitutes a somewhat formidable disease. A large purple tumour is situated within the anterior fontanelle, rising and falling with the pulsations of the brain communicated to it, and becoming distended and tense when the child cries. The tumour is evidently close upon the membranes of the brain, and may be looked upon almost as an intracranial rather than a scalp-tumour. The close proximity of the tumour to the brain and its membranes often deters practitioners from interfering with it; and I not unfrequently see cases in which the parents of the child have been counselled not to allow any operation to be practised, lest death should result. Yet this tumour, so formidable in appearance, and so deeply seated, close upon the brain, and as it were within the cranium, may be removed with the most perfect safety by the *ligature*. I have often tied *nævi* in this situation, and have never seen any ill consequences, not even a convulsive fit, occur. The danger, then, from the mere strangulation of the tumour in this situation cannot be great; but there is another and a special danger, *viz.*, the risk of wounding the membranes of the brain in passing the ligatures under the base of the tumour. If *nævus* needles, or sharp pointed instruments of any kind be used, this accident will be very likely to occur; and, if this were to happen, inevitably fatal consequences must ensue. This accident may always be avoided by operating in the following way. A puncture is made in front of the tumour through the healthy scalp. An eyed probe, armed with a double ligature, is then pushed through this opening across the base of the tumour, and its end is made to project on the opposite side beyond it; here another puncture is made, and the probe and ligature together are drawn through. The same procedure is adopted across the tumour ant-

ways. In this way, a quadruple ligature is passed across the tumour in two opposite directions; the ends are then disengaged, and the ligature is tightened in the ordinary way.

Nævi of the Face are of very common occurrence, and usually cause much disfigurement. The treatment to be adopted necessarily varies greatly, according to the nature of the *nævus*, whether cutaneous, subcutaneous, or both; and especially according to its situation. The same plan, which is advantageously adopted in one part, may be altogether inapplicable in another. We shall, accordingly, consider the treatment of these vascular growths, as they affect the eyelids, the nose, the cheeks, and the lips.

Nævus of the Eyelids is usually cutaneous, consisting of a discoloration or staining, as it were, of the lid, without any material swelling of it. Such a disease is, I think, better left untouched; it cannot, of course, be removed either by the knife or by caustics, without producing worse results; and, as the skin is always deeply involved, milder means are inoperative, or possibly equally destructive. I have heard of sloughing of the eyelid being occasioned by the use of astringent injections in such cases; though, if the *nævus* were subcutaneous, and constituted a distinct tumour, passing perhaps into the orbit, injection with the perchloride of iron might advantageously be adopted.

Nævus of the Nose may occur in two situations—at the root, or towards the alæ and apex. When seated at the root of the nose, upon the bridge, or at the lower part of the forehead, between and perhaps extending above the eyebrows, it is often subcutaneous, and may attain a very considerable magnitude. In cases of this kind, I have found the *quadruple ligature* the readiest means of removal; and, although the part included may be of large size, the resulting cicatrix is wonderfully small and narrow, usually becoming horizontal, so as to fall into the folds of skin naturally existing in that situation. In the case of a little girl about three years of age, brought to me some years ago by my friend Dr. Gerber, I removed a *nævus* that was cutaneous as well as subcutaneous, and as large as a walnut, from this situation, by means of the quadruple ligature, with the most satisfactory result, the resulting cicatrix being remarkably small; and in another little girl, from the bridge of whose nose I removed, some years ago, a *nævus* as large as a marble, very little scarring or deformity resulted. In both these cases, the *nævus* was cutaneous as well as subcutaneous. If the skin be not affected, injection of perchloride of iron may be advantageously employed in such cases. When the tip and alæ of the nose are affected, the *nævus* being cutaneous, we can seldom do much to improve the appearance of the patient. In such cases, I have tried breaking down the *nævus*, and the galvanic caustery, without any material benefit; the destruction of the tissues soon afterwards leading to deformity in the organ. When the *nævus* is subcutaneous, occupying the tip, alæ, and columella nasi, injection with perchloride of iron is the only means that I have found of real service. In doing this, care must be taken not to throw in too much of the liquid, lest sloughing result.

Nævi of the Cheeks may occur in three distinct forms. 1. There may be a simple cutaneous *nævus*, a mere staining of the skin, a "mother's mark." This admits of no treatment; and the subject of it must submit to continue through life to exhibit the characteristic discoloration. 2. The elevated cutaneous *nævus* is raised above the surface, and is of a deep purplish red or plum colour, covered with a very thin integument. In this form of the disease, I think that the application of concentrated nitric acid is the best means of extirpation. By one or two free applications of the caustic,

the nævous growth is removed, and a dense white cicatrix, presenting little disfigurement, is left in its place. 3 The nævus may involve the whole thickness of the cheek, being scarcely, if at all, cutaneous. Nævi of this kind cannot, of course, be extirpated, either by the knife, ligature, or caustics, lest the cheek be perforated, and the most serious disfigurement ensue. In such cases as these, we must endeavour to obliterate the structure of the nævus by exciting inflammation in it by means of setons, or by breaking down the structure of the growth with cataract-needles or a fine tenotome. In a case which I attended some years ago, with my friend Mr. Bartlett of Notting Hill, a large and deeply seated nævous growth, which occupied one cheek, was cured by having a number of fine silk threads passed across it in different directions; and then being gradually, piece by piece, broken down with a cataract-needle, no disfigurement whatever being left.

Nævi of the Lips require different treatment, according as they occupy the margin or have involved the whole substance of these parts. When seated at the margin, as projecting and somewhat pendulous growths, they may very readily be removed by a double or quadruple ligature, according to their size. This was the practice pursued in the case from which the accompanying drawings (Figs. 217, 218) were taken, where a most excellent result was



Fig. 217.—Nævus of Lower Lip:
Front View



Fig. 218.—Nævus of Lip:
Side View

obtained by the use of the ligature, followed at a later period by injection of perchloride of iron into some of the more widely diffused parts of the nævous growth. When the nævus involves the whole thickness of the lip, such measures are not always available. If it deeply invades the substance of the lips, an operation somewhat similar to that for the removal of a canceroid growth might be practised; the whole substance of the lip being cut through widely on each side, and the edges of the incision brought together with hare-lip pins. Such an operation is only practicable when the disease, though deeply seated, does not spread to any very great extent laterally. When it does, the whole of one-half of the lip, for instance, being involved, the use of the knife, especially in young infants, would be too hazardous, on account of the probability of serious hemorrhage; and other means must be employed. I have tried the use of setons, and of injections with perchloride of iron; but not with any advantage. When the whole substance of the lip is involved, inclusion and strangulation of the morbid mass by means of the ligature is seldom available, the amount of sloughing being very great, and the child, absorbing the putrescent matters from the sloughing mass which results, incurring the danger of being poisoned from this source. In an infant with a very large nævus, including one-half of the lip, which I ligatured at the hospital some years ago, death appeared to result from this cause. One of the most formidable cases of nævus of the lip that I have ever had to do with, and in its results the most satisfactory, was sent to me about nine years ago, by Dr. Budd of Barnstable. The patient, a little girl five months old, was noticed at birth

to have a red streak on the right side of the upper lip ; this rapidly developed into a large tumid purple nevus, which, when the case came under my



Fig. 219.—Large Nevus of Upper Lip.
Front View.



Fig. 220.—Large Nevus of Upper Lip.
Side View.

observation, was of about the size of a large walnut, involving the whole of the structures of the lip, from the cutaneous to the mucous surfaces : it was of a deep mulberry colour, and extended from the median line of the lip to the angle of the mouth (Figs. 219, 220). The integuments covering this growth were exceedingly thin, and the tumour itself was in the highest degree vascular and active. Excision appeared to be out of the question ; the ligature presented little to recommend it ; injections with the perchloride of iron and the introduction of setons were successively tried, but neither of these means produced any effect on the tumour, which commenced to extend upwards into the nostril. I accordingly determined on using caustics. Nitric acid was first employed ; but, as this did not produce sufficiently deep impression on the growth, I had recourse to the potassa cum calce. By means of this, the tumour was gradually removed ; the hemorrhage which occasionally resulted being restrained by pressure. Notwithstanding the amount of tissue destroyed, the resulting cicatrix was small, resembling that of a badly united hare-lip. Three years afterwards, the child was brought to me again, and I was much struck by the wonderful improvement that had taken place since the removal of the nevus. The lip was smooth, the cicatrix in a great degree worn out, and comparatively little disfigurement was left in the countenance of an exceedingly pretty and engaging child. Finding, however, that the lip was still drawn or tucked in by a very dense band of cicatricial tissue, which caused a depression of the ala on that side, I divided this, and the result was of the most satisfactory character.

Nævus of the Tongue is of rare occurrence. I have, however, successfully operated by means of the écraseur in one case, in which the whole of the free extremity of the organ was involved (Fig. 221). The particulars will be found in Chapter lvi.

Nævi of the Organs of Generation are occasionally met with in the female, but rarely in the male. The only instance of *Nævus of the Penis* with which I have met occurred in the case of a gentleman thirty-two years of age, who consulted me some years ago for a growth of this kind, as large as a walnut, situated under the reflexion of the preputial mucous membrane. It had existed for many years without giving any annoyance, but, as it had of late begun to enlarge, and occasionally to bleed, he was desirous to have it removed. This I did by applying the quadruple ligature, after having dissected down to the mucous membrane.

Nævi of the Vulva and Pudendum are by no means of very unfrequent



Fig. 221.—Nævus of the Tongue.

occurrence. We have had several instances of this kind in the Hospital of late years. They are usually of a venous character, often attain a large size, and may sometimes involve the integumental structures on the inside of the thigh, or on the perineum, as well as the vulva. When the growth is confined to the vulva, it is best removed by the ligature. Some time ago, I removed in this way a large venous pendulous nævus, as large as two or three flattened walnuts, from the left labium of a little girl six years of age. In this case I found it most convenient to employ the continuous ligature. The same means were had recourse to in order to extirpate a large nævus from the labium of a child three years of age; but in this case the disease extended to the integuments of the perineum and inner side of the thigh, and was here removed by the application of strong nitric acid, after the larger growth had separated.

On the *Extremities, Neck, and Trunk*, every possible variety of nævus occurs. When the disease is flat, consisting rather of staining of the skin than of any actual tumour, it may commonly be treated successfully by the application of the strong tincture of iodine; or, should it be thought desirable to remove it, this may be effected by rubbing it with strong nitric acid. If the nævus assume the form of a tumour, it will almost invariably be of a venous character, and then removal by means of the ligature should be effected. If the growth be round, the ordinary quadruple ligature may be employed, if flat or elongated, the longitudinal continuous ligature is preferable.

NÆVOID LIPOMA.—This is a form of nævus with which I have occasionally met, but which does not appear to have attracted much notice, although I find that Nélaton speaks of it. It is a tumour in which the nævoid structure is conjoined with or deposited in a cellulo-fatty mass. This disease is invariably seated upon the nates, back, or thigh. It occurs as a smooth, doughy, indolent tumour, incompressible, not varying in size or shape, without heat, thrill, or pulsation of any kind, possibly having a few veins ramifying over its surface, but no distinct vascular appearance. It is usually congenital, or has been noticed in early childhood; and continues without any very material change in shape, size, or appearance, until the inconvenience or deformity occasioned by it requires its removal. This is best effected by the knife. After removal, the tumour will be found to be composed of a cellulo-adipose basis, having a large number of veins ramifying through it, so as to constitute a distinct vascular element, communicating with small cysts containing a bloody fluid. The tumour has occasionally a tendency to recur after removal. In one case I have operated three times for the removal of a large growth of this description, situated on the buttock, and extending forward towards the perineum. The first operation was performed in 1851; the second, in 1856; and the patient, now eighteen years of age, has again (1863) presented himself, with a recurrence of the growth, in an ulcerated state, in the cicatrix of the former operations. The situation in which I have seen such tumours occur, where they gave rise to most inconvenience, and where their removal has required the greatest care, has been the anterior part of the thigh, just below Poupart's ligament, close upon and almost in connection with the femoral vessels. In a case of this description, which was sent to me by my friend Dr Edwards of Antigua, the patient, a gentleman of that island, had suffered from a chronic solid oedema of one of his legs for some years, apparently dependent upon the pressure exercised upon the axillary and femoral veins by an elongated indolent tumour just below Poupart's ligament, and over the course of these vessels. This tumour had existed from childhood, and presented the signs that have just been given as charac-

toristic of the disease under consideration. It was removed by an incision parallel to Poupart's ligament, some careful dissection being required to separate it from the femoral sheath, more particularly towards the inner side, where a prolongation of the tumour dipped down by the side of the femoral vein, doubtless compressing that vessel, and so disposing to the occurrence of the œdema of the limb. After removal, the tumour was found to consist of a mass of condensed cellulose adipose tissue, with much vascular structure intermixed, and some small cysts. The œdema gradually subsided; and when the patient left England, about three months after the operation, the limb had nearly regained its normal size, being but little larger than the sound one.

HEMORRHAGIC DIATHESIS.

In connection with diseases of the arteries, it may be stated that in some constitutions it is found, though fortunately very rarely, that there is a great tendency to very troublesome, indeed almost uncontrollable bleeding, from trivial wounds; life being put in jeopardy, or even lost, by the hemorrhage resulting from the extraction of a tooth, the opening of an abscess, lancing the gums, or some equally slight unimportant surgical procedure. The blood does not flow in a jet, but continues to trickle in an oozing stream, apparently from the capillaries rather than from the arteries of the part. In these cases also there is a great tendency to an inordinate amount of ecchymosis from very slight contusion, the cellular tissue becoming rapidly filled with fluid uncoagulable blood.

CAUSES.—The "hemorrhagic diathesis" appears to be connected with or dependent upon one of three distinct conditions.

1. It may be congenital, and not unfrequently is hereditary, especially in the male line, in persons otherwise robust and strong, without any apparent derangement of health, or morbid condition, innate or acquired, to account for it. In such cases the family peculiarity is usually recognised, and well known to those liable to it.

2. The hemorrhagic diathesis may occur in individuals from some fault in the solid constituents of the body. In persons who are "out of condition," with soft and flabby texture, the tissues have lost their normal contractile power, and are too readily torn by external violence. In such individuals slight blows may be followed by extensive extravasation, and trivial wounds by abundant and continuous hemorrhage. The bleeding in these cases appears to be favoured by the laxity of fibre interfering with the proper contractility of the divided vessels.

3. The hemorrhagic diathesis may be dependent upon a morbid state of the blood itself, in consequence of which it has lost its coagulability, the fibrine being insufficient in quantity. This is especially apt to occur as a consequence of diseases that produce a diffuent state of the blood, such as chronic jaundice, albuminuria, scurvy, &c.

The last two conditions are not unfrequently associated together, the blood-vessels being insufficiently contractile, and the blood too poor in fibrine, when excessive hemorrhages are apt to occur from the most trifling wounds. In cases of this kind, care must be taken not to make any surgical wounds if they can possibly be avoided; though it is a remarkable fact, that the hemorrhagic tendency here described seems only to have been met with after trivial injuries of the kind above mentioned, and not to have been encountered in any really serious surgical case.

TREATMENT.—In the treatment of the diathesis, little can be done. It has been proposed to administer saline hydragogue purgatives, with a view

of inspissating the blood. I should, however, imagine that an improvement of the general health, by careful attention to food, exercise, &c., would be the best means of increasing the plasticity of this fluid. In the event of the occurrence of actual bleeding, the employment of pressure, the application of the actual cautery, or the use of the perchloride of iron, will constitute the best means of arresting the hemorrhage. In some cases the electric cautery may be advantageously substituted for the knife, when it is desirable to remove parts in persons suffering from this diathesis. By this means the smaller amputations even may be performed, as has been successfully done by Mr. Marshall.

CHAPTER XLV.

DISEASES OF THE NERVOUS SYSTEM.

NEURITIS.

Inflammation of the Nerves, or Neuritis, is not of very unfrequent occurrence, being usually the result of rheumatic inflammation, of wounds, or strains. When rheumatic, it principally affects the nerves of the face and of the lower extremity.

SYMPTOMS.—These consist of tenderness on pressure along the course of the nerve, and severe continuous pains ramifying down its trunk and branches, with occasional violent exacerbations, especially on moving or touching the part, and at night; there is usually swelling along the course of the trunk, and some constitutional pyrexia. When chronic, this condition may readily be confounded with neuralgia; of which, indeed, it constitutes one variety. On examination after death, in these cases, the sheath of the nerve will be found injected and swollen, and the nervous tissue softened.

TREATMENT.—This consists in the employment of antiphlogistic means, cupping or the application of leeches, according to situation, poppy, or belladonna fomentations, and local emollients. When the neuritis is rheumatic, the acetous extract of colchicum is the best remedy; when it is of a more chronic and nocturnal character, iodide of potassium, either alone or in combination with sarsaparilla, may advantageously be given.

NEURALGIA.

Neuralgia frequently occurs in surgical practice, either complicating other diseases, or as a distinct affection simulating closely various organic lesions, more especially of joints and bones.

SYMPTOMS.—The pain in neuralgia is the essential symptom, and in fact constitutes the disease itself. It may be of two kinds; either following anatomically the course of a nerve and the distribution of its filaments; or affecting a considerable portion of the surface without reference to any special nerve. It is of all degrees of severity, sometimes moderate, sometimes unendurable, even by those who possess the greatest fortitude; when severe, it usually comes on suddenly, with a kind of shock, and continues of a sharp darting or tearing character, coursing along the trunk or ramifications of the affected nerve, the distribution of which may often be distinctly indicated by the direction the pain takes. It is often accompanied by other sensations, such as a tickling, smarting, or creeping feeling on the affected surface, in some instances relieved by pressure, in others increased by the slightest

touch or movement of the part. Occasionally there is spasm in the muscles supplied by the affected nerve; in other cases, there are heat and redness of the surface, with increased secretion from the neighbouring organs, as a flow of saliva or tears when the nerves of the jaw or eye are implicated. The duration of an attack may vary from a few moments to many days or months. The pain is most commonly intermittent or remittent; often irregularly so, but in some instances the periodicity is well marked.

SITUATIONS.—This disease may affect almost any part of the body; it is most commonly seated distinctly in the trunk and branches of a nerve. The divisions of the fifth pair are especially liable to be affected; the pain may extend to the whole of the branches of this nerve on one side of the head and face, but more commonly it is confined to one of its principal divisions, such as the infraorbital, which is especially liable to be affected; in many instances it is seated in the temporal and dental nerves. Not unfrequently some of the terminal twigs alone of one of these nerves, become the seat of intense pain; thus occasionally the affection is found limited to a patch on the cheek, brow, or temple, from which it scarcely ever shifts. The posterior branches of the dorsal spinal nerves, and the intercostals, are also very commonly affected, though not to the same extent as the fifth pair. In other cases the whole of an organ, or part, becomes the seat of neuralgia, though no one nerve may appear to be distinctly implicated; thus the testes, the breast, the uterine organs, or one of the larger joints, as the hip or knee, are occasionally the seats of severe suffering of this kind. An extreme degree of cutaneous sensibility is a marked feature in the affection in some cases; the patient wincing and suffering severely whenever the skin is pinched or touched, however lightly.

CAUSES.—The causes of this very painful disease are very various; they may be constitutional or local. It seldom occurs in strong and healthy individuals, but is almost invariably associated with want of power, unless it be occasioned by some local mechanical cause. *Depressing influences* of all kinds are especially apt to produce it; thus, debilitating diseases, mental depression, and particularly exposure to malaria, are common occasioning causes; those forms of the disease that arise from malarial influences, or from exposure to simple cold and wet, usually assume a very intermitting or periodical character, and are commonly seated in the nerves of the head. The *hysterical temperament* very frequently disposes to the spinal and articular forms of neuralgia. There is no constitutional condition with which neuralgia is more frequently associated than with *anæmia*: hence its frequency in females. As Romberg says, "Neuralgia is the prayer of the nerve for healthy blood." Various sources of *peripheral irritation*, as loaded bowels, the irritation of worms, carious teeth, uterine disease, and calculus, may be recognised as producing some of the more obscure varieties of the disease.

Neuralgia may also arise from any compression exercised upon the trunk of a nerve; and in this way, indeed, some of the more intractable forms of the affection have their origin. Thus, thickening of the neurilemma, the pressure of a tumour of any kind, or of a piece of dead bone, may give rise to the most intense pain in the part supplied by the irritated nerve; and it is not improbable that in many of the cases of neuralgia in the branches of the fifth, pain may be owing to periosteal inflammation, or to some other disease of the osseous canals through which these nerves pass.

DIAGNOSIS.—The diagnosis of neuralgia, though usually effected without any difficulty, is in some cases a little embarrassing, as the pain may occasionally simulate that of organic disease or inflammation of a part. From organic disease of the part that is the seat of suffering, such as the hip, the

knee, the testis, or the breast, this disease may usually be distinguished by the co-existence of cutaneous sensibility, the existence of the hysterical temperament, and the absence of the other signs that would accompany lesion of structure in the part affected. From inflammation the diagnosis is usually sufficiently easy, by attending to the intermittent character of the neuralgic pain, to its occurrence in hysterical temperaments, and to the absence of the constitutional symptoms of inflammation. But occasionally, when local inflammatory irritation is conjoined with the neuralgia, the diagnosis is truly difficult. Here the presence of cutaneous sensibility and the relief of the pain by firm pressure will indicate neuralgia; whereas, in inflammation, there is no tenderness of surface, but the suffering is aggravated by deep pressure.

TREATMENT.—The treatment of neuralgia must have reference to the cause of the disease, and will be successful or not according as this may be more or less readily removed. So long as the conditions that primarily occasion the disease subsist, the pain is likely to continue: and if these conditions be irremovable, the disease may be looked upon as necessarily incurable, though the suffering may be alleviated by appropriate means. When it arises from any central nervous affection, there may be fear of the ultimate occurrence of disease of a more serious type, such as epilepsy, insanity, &c.

When it occurs as the consequence of anemia, or in the hysterical temperament, the administration of the more stimulating and stronger preparations of iron, such as the sulphate or the sesquichloride, or the *mistura ferri composita*, either alone or in combination with quinine, with attention to the state of the bowels and of the uterine functions, and a general tonic regimen calculated to brace and improve the general health, such as sea-bathing, the cold douche, or sponging, will be found to be of essential service. In some of these cases the combinations of zinc, especially the valerianate, with the fetid gums, will remove the disease when iron does not influence it much. At the same time, the application or inunction of belladonna or acouite plasters and liniments may be of service. When the neuralgia is distinctly periodical, quinine in full doses, or the liquor arsenicalis, will usually effect a speedy cure. When it is rheumatic, occurring in debilitated subjects, and attended by distinct nocturnal exacerbations of pain, no remedy exercises so great an impression upon it as the iodide of potassium, especially when administered in combination with quinine.

In the more severe and protracted forms of the disease, relief may be occasionally obtained by attention to the state of the liver and digestive organs, by a course of some of the more purgative mineral waters, and by the occasional administration of aloetics or croton oil, followed by tonic remedies.

Local applications of a sedative kind, such as chloroform, belladonna, opium, &c., are often useful adjuncts to constitutional treatment. Perhaps the readiest mode of affording relief locally is that introduced by Dr. Alexander Wood of Edinburgh. This consists in injecting a few drops of a strong solution of morphia into the skin of the part affected, by means of the syringe figured at p. 683. Not more than half a grain of morphia should be injected at a time, and the action of this small dose is often very powerful. More than this, I believe, would be unsafe; but the injection may be repeated, if necessary, at intervals of an hour. In some cases of simple neuralgia, Pulvermacher's galvanic chain has afforded relief.

In many cases all these means, however, are unfortunately unavailing, and the sufferer is doomed to an existence of constant pain, except when the disease appears to cease of itself, or has its intensity blunted by the adminis-

tion of the more powerful sedatives, such as morphia externally, or opiate or atropine externally. In these distressing cases the sufferer is only to grasp at any means of relief that is held out to him, and section of the affected nerve is not unfrequently recommended as a last chance of the cural of the disease. It is clear, however, that such an operation, though occasionally productive of temporary relief, cannot in many cases be expected to benefit the patient materially; for by it the cause of the neuralgia is not removed, and it can consequently only be of service when the pain is peripheral, occasioned by some local irritation existing between the part cut and the terminal branches of the nerve. If the neuralgia depend on any central cause, or on local irritation existing higher up than the point divided, it must eventually be useless. Thus, if the source of irritation exist in the central branches of the infraorbital nerve, the division of this trunk might be useful, but if the pain be occasioned by any pressure to which this nerve may be subjected in its passage through its canal by a carious state of the bone, or by disease of the periosteum, it would be unavailing; though it is a remarkable fact, that it not unfrequently happens after these operations that there is a temporary cessation in the pain for a few weeks or months. In some of these cases, however, the pain shifts its seat from the branch operated on to another division of the same trunk; thus, if the infraorbital nerve been divided, the submental nerve becomes the seat of pain. Or this may be accidental, as it were, to the point at which the nerve was divided; thus, after amputation for neuralgia of the knee, the pain may return in the stump, and again when this is removed a second or even third time.

The nerves on which section has been most frequently performed are the infraorbital and the submental. Should it ever be thought necessary to do so, it would be proper not only to divide the nerve, but to excise a portion of it, otherwise reunion will speedily take place, and, the continuity of the nerve being re-established, the operation will fail. The procedure simply consists in cutting down on the trunk where it escapes from the foramen, isolating and dissecting out a portion of it; in doing this, no great difficulty can be experienced by any one possessing moderate anatomical knowledge.

NEUROMA.

By *Neuroma* is meant a tumour connected with a nerve. This tumour may vary from the size of a millet-seed to that of a melon; it is usually sessile, and composed of fibrous tissue; but when it attains a large bulk, a cavity may form in it, containing a yellowish or brownish serous-looking fluid, apparently owing to the disintegration of the central portions of the mass. In shape it is usually oval or oblong, the long axis corresponding to the course of the nerve (Fig. 222); it grows slowly, and is moveable transversely, but not in the direction of the nervous trunk on which it is seated; it has no appearance of malignancy, and, however large it becomes, it never contracts adhesions to the integument nor involves its structure. Neuroma commonly only affects the nerves of the cerebro-spinal system; but Bérard has met with one case of the disease on a ganglionic nerve. The nerves of special sense are but very rarely the seat of this disease. Indeed the only recorded case with which I am acquainted of a neuroma connected with one of these nerves, is one described by Dr. Lidel of New York, of a neuroma of the optic nerve filling up the orbit, flattening and protruding the eye, and extirpated together with the contents of the orbit by that surgeon.

Most commonly the tumour is single, and then is usually attended with very severe lancinating or neuralgic pain, which extends, however, only to

the parts below the tumour, and is commonly paroxysmal. This pain is evidently owing to the stretching of the nervous twigs as they pass along the convexity of the growth. When acute and painful, the tumour commonly goes by the name of the *Painful Subcutaneous Tubercle*, and is then usually met with from the size of a pin's head to that of a cherry-stone, commonly seated upon the limbs, and most frequently in connection with one of the nerves of the lower extremity; but it may be situated upon the arm, the trunk, or even on the scrotum and cheek, where, however, it is not so commonly met with. Wherever neuroma occurs, it is acutely and intolerably painful on being touched, and is usually tender as well.



Fig. 222. — Neuroma, with Nervous Filaments spread out over Tumour.

STRUCTURE.—The painful subcutaneous tubercle is composed of a white or greyish fibrous mass developed in the neurilemma, and having nervous filaments stretched through or over it. The nervous trunk above and below the tumour is normal; it is only where it comes into contact with the neuroma, and is exposed to its pressure, that it undergoes the change indicated. It is a very remarkable fact that, though neuromatous tumours when single, or when but two or three exist, are most acutely painful, yet, when they are generally diffused over the body, they lose their sensibility, and are unattended by any inconvenience except such as arises from their numbers and bulk. The number of masses thus formed is often amazingly great; thus, in one of Dr. R. W. Smith's cases, described in a monograph which contains the fullest and most accurate account of this disease, he counted in the two lower extremities alone more than 250 of these tumours, besides those in other parts of the body. In another case related by him, there were upwards of 200 small neuromata scattered over the sides of the chest and abdomen, 450 on the right lower extremity, and upwards of 300 on the left; altogether probably not less than 2000 of these growths in "this unprecedented case."

Traumatic Neuromata may arise from the wound or partial division of nerves, and occasion the most intense agony. Sometimes growths of this description, of a fusiform shape, and varying from a cherry-stone to a pigeon's egg in size, are met with in stumps after amputations; in many instances they are unattended by inconvenience, but occasionally give rise to a very severe degree of pain.

TREATMENT.—The treatment of painful neuromata, whether of an idiopathic or traumatic character, or existing in stumps, consists in their excision. After removal, the part supplied by the nerve, which is usually necessarily divided, becomes paralysed for a time, but may eventually regain its sensibility. In some cases, however, by cautious dissection, the tumour may be removed from the nerve that is in contact with it, without cutting this across. This has been done in the case of neuromata of the sciatic nerve and its divisions. When these tumours are numerous, they should not be interfered with; and, if unattended by pain, they need not be excised unless their bulk prove inconvenient.

TETANUS.

Tetanus is a disease consisting essentially in an excited state of the spinal cord and the medulla oblongata, in fact of the whole true spinal system,

ing rise to painful and continued spasms of the voluntary muscles and the diaphragm, alternating with incomplete relaxation, and usually terminating fatally. This, which is one of the most serious and distressing diseases to which the nervous system is liable, is in the great majority of instances of a *Traumatic* nature, being the consequence of some wound that implicates or irritates a portion of the peripheral nervous system; the local irritation so produced being propagated to and exciting the nervous centres, the excitation of which becomes persistent, and continues after the local cause has been removed, inducing reflex muscular movements in various parts of the body. The irritation of the nervous system, however, that induces tetanus, may arise from other sources besides surgical wounds, assuming the *Idiopathic* form of the disease; thus, for instance, the presence of worms in the intestinal canal, exposure to cold and wet, the ligature of the navel in infants, and even the uterine irritation following abortion, have been known to occasion it. These causes, however, rarely give rise to it in this country, and we must consequently regard it as a disease chiefly arising from traumatic lesion of some kind.

Tetanus may occur at all ages, from the earliest infancy to an advanced period of life. In hot climates it is common amongst newly born infants, in the form of *Tetanus Neonatorum*. In this country it rarely occurs at the very early period of life, but is common in young adults. I have most frequently observed it between the ages of 16 and 25, and after that in old people, but it may occur at any period of life. It is far more common amongst males than females—in the proportion of about four to one. Season of the year seems to exercise little influence over it. It occurs in all states of the atmosphere, and at all periods of the year; but is certainly most common when the weather is suddenly changeable—alternating from heat to cold.

CAUSES OF TRAUMATIC TETANUS.—Tetanus may be occasioned by injuries that do not give rise to breach of surface; thus I have known it occur in a child who was suddenly thrown down upon its back by another at play; and Dr Reid mentions a case produced by the stroke of a whip. But in the great majority of cases, it is directly occasioned by a wound of some kind. Generally a nervous twig has been lacerated, divided, or inflamed; thus, in a case of tetanus following a wound of the knee, in a patient who died in University College Hospital, a small branch of the internal cutaneous nerve was found to have been injured, and was inflamed; and in another patient who died of tetanus about sixteen days after treading on a rusty nail, a black speck was found on the internal plantar nerve, where it had been wounded by the nail. In another case under my care, in which tetanus resulted from a bruise of the back, and terminated in death, the injured nerve (a dorsal branch) was found lying bare and reddened in the wound; and, on tracing it up to the spinal cord, its sheath was found to be much injured, ecchymosed, and with a large vessel running down it. In another instance, in which tetanus followed a wound of the wrist, the external cutaneous nerve was found in a similarly inflamed state.

The kind of wound, as well as its situation, doubtless influences materially the occurrence of the disease. Though it certainly more frequently follows punctured, torn, and lacerated, than clean-cut wounds, yet it occasionally complicates these, even when the result of surgical operations; thus, it has been known to follow the removal of the breast, amputations, the ligature of the larger arteries, and the operation for hernia. The minor surgical operations also are not free from the possibility of this dangerous complication. It has been observed after the operation for fistula in ano, the ligature of

piles and varicocoele, the removal of nasal polypi; and I have even seen a fatal case resulting from the introduction of an issue. Burns are a class of injuries that are peculiarly liable to be followed by tetanus. It is the common belief, both in the profession and out of it, that wounds of the hands and feet, and more especially of the ball of the thumb and of the great toe, are more likely to be followed by tetanus than those in other situations. I think the truth of this opinion may be doubted; though it is not improbable that tetanus may occur more frequently after injuries of these regions than of other parts of the body, simply because punctured and lacerated wounds are more common here than elsewhere. It cannot well be supposed to be owing to the tendons and fasciæ that abound here, as Hunter imagined; for it is seldom, if ever, met with after operations for tenotomy, which are so commonly practised on the feet.

Tetanus may occur in all *constitutions*—in the strong and robust, and in the feeble and emaciated. It is especially apt, however, to occur in feeble and debilitated individuals, and, indeed, may be looked upon as a disease of debility; hence any condition that lowers the tone of the nervous system is especially likely to occasion it. When it occurs in persons who are otherwise strong and in the prime of life, it will be found that they have been exposed to causes of depression influencing the nervous system. It is loss of nervous tone, and not muscular weakness, that disposes to this disease. Thus, in tropical climates, as in some of the West India Islands, and amongst the marshes of Cayenne, it occurs with peculiar frequency, the most trifling scratches or punctures being followed by the disease. Mr. Poland, who has exhausted the statistics of tetanus, states that the mortality from it is in London '025, whereas in Bombay it is 2·5 per cent. of the total deaths. It is interesting to observe, that the natives of hot climates are far more liable to this disease than Europeans resident there.

In military practice tetanus is of common occurrence. Its frequency varies much in different campaigns and under different circumstances. In the Peninsular War, it was estimated to occur in the proportion of about one case in every 200 wounded; in the Schleswig-Holstein war, according to Stromeyer, once in about 350 cases. In the Crimea it appears to have been of rare occurrence. Alcock's estimate of one to every 79 wounded is evidently too high. After naval engagements, the mortality has often been high. Sir G. Blane states that, after Rodney's action, out of 810 wounded 20 were attacked with tetanus, being one in 40. All army surgeons are agreed, that sudden changes from heat to cold are amongst the most frequent causes of tetanus amongst the wounded. Thus Larrey states that, after the battle of Moskowa, although the number of wounded was immense, there were few cases of tetanus, the heat being very great and continuous; whilst after Bautzen, where the wounded were left on the field all night exposed to severe cold, more than 100 had tetanus; and after the battle of Dresden, when great heat was followed by much wet and cold, the wounded suffered most severely. So, after some of the Indian battles, as Chillianwallah and Ferozapore, where the wounded lay exposed to cold nights after very hot days (M'Leod), tetanus was of very frequent occurrence. Hennen states that a draught of air, whether hot or cold, directly blowing on the patient, is the most fertile cause of tetanus.

Tetanus at times appears to occur *epidemically*. It often happens that not one case occurs in a hospital for some years, and then several in close succession or simultaneously.

PERIOD OF OCCURRENCE.—Tetanus may take place at any period after the infliction of the wound that occasions it. In hot climates especially, it

may occur very speedily ; thus, Dr. Robinson relates the case of a negro servant in the West Indies, who scratched his finger with a broken plate, and died of tetanus in a quarter of an hour. It is very seldom, however, in temperate climates, that it supervenes before the fourth or fifth day, usually from that to the tenth day. Larrey, who had great experience of this disease during Napoleon's campaigns in Egypt, met with it most frequently between the fifth and fifteenth days after the infliction of the wound. According to the experience of the surgeons of the Peninsular War, under whose observation many hundred cases came, the disease does not show itself after the twenty-second day ; but though this may be the general rule, Sir G. Blane has related a case in which it took place as late as a month after the infliction of the wound. It is stated that it may occur after the cicatrisation of a wound is completed ; when this happens, the disease must rather be looked upon as being of an idiopathic character, accidentally occurring in a person who has been recently injured.

FORMS.—Tetanus may be *Acute* or *Chronic* ; being in some instances fatal in the course of a few hours, but usually lasting for three or four days. Poland states that at Guy's 51 per cent. of the cases were fatal before the fifth day after invasion. If the patient survive this time, the disease will commonly run on to the eighth or tenth day, and occasionally even for a longer period than this ; thus, S. Cooper mentions a case in which it continued in a soldier for five weeks after amputation. The more chronic it becomes, the better is the chance of recovery ; indeed, if the patient survive the tenth day, the prospect of a favourable issue to the case is materially increased. As a general rule, those cases are the most fatal which are most active in their symptoms ; the danger being in the ratio of the acuteness of the attack, both as to severity and also as to rapidity of invasion after injury.

SYMPTOMS.—The invasion of the disease is sometimes preceded by a general uneasiness on the part of the patient, a sensation of fear, or a sense of impending mischief. Abernethy was of opinion that tetanus was usually ushered in by a disturbed state of the digestive organs, the stools being offensive, and indicative of much gastric irritation. When the disease sets in gradually, it may be somewhat difficult of recognition in its early stages ; if it come on suddenly, its nature is immediately evident. It is a remarkable fact that the cramps do not begin in the part injured ; but, wherever this may be situated, they are always first noticed in the muscles supplied by the *portio dura* of the seventh nerve ; and throughout, these and the muscles of respiration are principally affected. The first symptoms usually consist in the patient being unable to open his mouth widely, to take food or drink, the muscles about the temples, jaw, and neck, feeling stiff and rigid ; this condition has given to the disease the popular term of *lock-jaw*. As the affection advances, the countenance assumes a peculiar expression of pain and anguish, the features are fixed or convulsed from time to time, and the angles of the mouth drawn up, constituting the appearance called the *risus sardonicus*. When fairly set in, the disease is marked by spasms of the voluntary muscles of the most violent character, with much pain and partial remissions. The pain is of that kind that attends ordinary cramp in the muscles, as of the legs, and is usually very severe. The spasms are often of a jerking character, the patient being suddenly thrown up, or twisted on one side ; the breath is drawn with a loud sobbing catch from spasm of the diaphragm, and from the same cause there is usually violent pain experienced in the epigastric region, darting across to the spine. The muscles of the trunk are usually affected next in order of frequency to those of the head and neck, the body being bent backwards so as to form a complete arch

(*Opiethotonos*) ; more rarely it is drawn forwards (*Emprosthotonos*) ; and still less frequently to one side. In some cases the body becomes perfectly rigid, like a piece of wood, the belly being drawn in, and the chest expanded. It is said that in severe cases the spasms have been of so violent a character, that muscles have been ruptured, teeth broken, and the tongue lacerated. In the numerous cases of tetanus that I have unfortunately witnessed, it has never fallen to my lot to see any effects of this kind produced ; the spasms, indeed, being in general not of a very violent, though of a continuous and very painful character.

The intellectual faculties are not disturbed in these cases, and the mind continues clear to the last. In most instances there are great heat of surface, profuse sweats, and quickness of pulse ; not from any febrile disturbance, for this disease is unattended by symptoms of pyrexia, but apparently simply from the violence of the muscular contractions. The prolongation of life appears to depend greatly upon the intensity of the convulsive movements : the more severe these are, the sooner does death result. The fatal termination occurs not so much from any great physical lesion, or disturbance of important parts, as from exhaustion, consequent on the frequency of the tetanic spasms.

PATHOLOGY.—The morbid appearances found after death from tetanus throw but little light on the real nature of this affection,—so little, indeed, that it is frequently looked upon as a “functional disease.” But in saying that this or any other disease is functional, we but express our ignorance of its real cause. There is no function without an organ to perform it ; and there can be no derangement of a function without a corresponding and concomitant disorder of the organ that produces it. Every “functional” disease must, therefore, at last be referred to an organic lesion. The term “functional” is only employed when we are not acquainted with the true nature of the disease. As less is known of the real physiology and pathology of the brain and spinal cord than of other organs of the body, we have more “functional” diseases of the nervous system than of the circulatory or respiratory. But, as pathological anatomy becomes more studied, and as minute investigations into structure are entered upon, so the class of so-called “functional” diseases becomes narrower. We do not speak of “functional” coma, because we can appreciate the different conditions that occasion compression of the brain ; but we still speak of functional convulsive diseases and of functional amaurosis. The ophthalmoscope, however, has shown that functional amaurosis does not exist, but that the failure of visual power is always accompanied by and dependent on some corresponding change of structure in the interior of the eye ; and thus advances in pathology will doubtless show that other so-called functional diseases of the nervous system have no existence. It is true that as yet no specific or positive or invariable derangement of the nervous centres has been met with in tetanus—nothing beyond conditions that are common to many other nervous affections, such as congestion and softening of the brain and spinal cord, with possibly reddish serum in the ventricles and subarachnoid space. But there is one morbid condition that will, I think, invariably be found ; viz., a marked congestion and inflammation of a nerve connected with, and leading from, the wound that has occasioned the disease. This morbid state I have never found wanting. In all cases of fatal tetanus that I have seen in which a careful dissection has been made, the signs of inflammation of a nerve communicating with the wound have been found ; and the vascularity, which is often very intense, may be traced up the neurilemma, often to a considerable distance.

DISEASES OF THE ORGANS OF SUPPORT AND MOTION.

CHAPTER XLVI.

DISEASES OF BONE.

PERIOSTITIS.

Inflammation of the Periosteum is of common occurrence as a result of injury, as a consequence of syphilis and rheumatism, or as a natural process dependent on disease of the subjacent bone. It often affects the entire bone covering the shaft of a bone, and very commonly attacks the articular end, becoming associated with inflammation of the contiguous joint. When it is acute, the membrane becomes thickened, soft, and vascular, and loosens from the subjacent bone. When chronically inflamed, the periosteum becomes thickened by the deposit of plastic matter within and beneath it, and the subjacent bone usually participates in the changes, undergoing hypertrophy and induration, constituting a *node*. In some cases, but rarely, suppuration and death of the layer of bone immediately subjacent to the affected membrane take place.

SYMPTOMS.—The symptoms of periostitis consist of a hard elongated but somewhat puffy swelling—a *node*—not distinctly circumscribed, and attended by much pain in the part, especially at night, with tenderness on pressure.

TREATMENT.—In the treatment of the acute form of the affection, the free application of leeches, with hot fomentations, and the exhibition of calomel and opium, will arrest the disease, and give relief to the patient. In the more chronic form, the continued administration of iodide of potassium will take down the swelling, remove the nocturnal pains, and materially improve the local condition of the part. In those cases of periostitis which are of a syphilitic character, iodide of potassium may almost be looked upon as a specific. Added to this, the occasional application of leeches and repeated blistering will be of essential service. If there be much thickening, considerable relief will be afforded by the free division of the periosteum down to the bone, either through the skin or by means of a tenotome slid under it.

OSTEITIS.

Inflammation of Bone may arise from the same constitutional causes as the preceding disease, but most commonly occurs as the result of injury, either accidental, or inflicted by the surgeon in an operation. When a portion of bone is inflamed, the periosteum and medullary membrane participate in the morbid action, and, together with the affected osseous structure, become highly vascular; at the same time the inflamed bone becomes expanded and softened, partly in consequence of changes induced in its organic constituents, and partly in consequence of the cancellated structure becoming more cellular from interstitial absorption; the cells being filled with a sero-sanguineous fluid. The compact structure of inflamed bone undergoes a peculiar kind of

eight, or ten hours, the condition of the patient being looked to in the meanwhile. Sedative or antispasmodic agents are of no use in acute tetanus. I have seen many drugs of this kind employed without producing any effect in lessening the violence of the convulsions. In most cases, however, the inhalation of ether or chloroform materially lessens their severity, and gives the patient temporary ease.

In the *Subacute* or *Chronic* form of the disease recovery is much more likely to take place; and it is only in these cases that antispasmodics and sedatives, such as opium, camphor, conium, belladonna, and aconite, have been of use; and in these also, chloroform is far more beneficial than in the acute cases. There is a kind of trismus occurring in females, often of a hysterical nature, which is at once removed by the inhalation of chloroform. Professor Miller speaks highly of cannabis Indica pushed to narcotism; three grains of the extract, or thirty minims of the tincture, being given every half hour or hour; and the Rev. Dr. Houghton has employed nicotine in one-drop doses, administered every second hour, with complete success in severe cases of traumatic tetanus. In one case, at Dr. Garrod's suggestion, I tried atropine endermically on a blistered surface, and gave conium internally in large doses; and although the patient, an old man, eventually died exhausted, yet these agents appeared to exercise a marked influence in diminishing the violence of the spasms, and I should be induced to attach some importance to their administration. Dr. Elliotson has spoken highly of the preparations of iron, especially of the carbonate, in tetanus. At the same time that recourse is had to such measures as these, it must not be forgotten that the disease is one of great exhaustion, and that the patient will die worn out, unless he be supplied with plenty of nourishment. Beef-tea and wine should, therefore, be administered by the mouth, and nutritious enemata by the rectum; and in this way the powers of life may be supported until the violence of the disease expends itself. I am, however, disposed to think that even in these chronic cases much more may be done by simple than by specific treatment. Clearing out the bowels by turpentine enemata, the internal administration of calomel with opium, and keeping up the powers of the system till the disease wears itself out, appear most likely to be followed by a satisfactory result, when used in addition to the hygienic measures recommended in the acute form of the disease. It is certainly more rational to employ such measures as these, than to be constantly recurring to antispasmodics and sedatives, which repeated experience has proved to be useless as curative agents, in the vain hope of finding a specific for tetanus.

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laminated expansion, so that a section of it presents an appearance of concentric parallel layers. When the inflammation is chronic, the bone is likewise expanded, but instead of becoming looser in its texture and softened, as in the acute form of the disease, it becomes very dense, indurated, and compact; looking and cutting more like ivory than ordinary bone. Sometimes considerable elongation without much or any thickening will take place. I have seen, as the result of chronic osteitis, the tibia from one and a half to two inches longer than its fellow.

SYMPTOMS.—The symptoms of osteitis consist of enlargement of the affected bone, with deeply seated pain and great tenderness in the limb; the pain, as in periostitis, is greatly increased at night, and when the disease is chronic, is much influenced by the state of the weather.

TREATMENT.—In the treatment of the *acute* cases, our principal reliance must be on local leeching, with calomel and opium. In the more *chronic* form of the affection, when the bone has become thickened and enlarged, nothing of a curative kind can be adopted; and the only remedy consists in the administration of iodide of potassium for the relief of the pain, with perhaps the occasional application of leeches. Should these means fail in giving relief, and the pain continue of an excessively distressing and persistent character, I have found that a cure may be effected by cutting down on the thickened osseous node, and then making a longitudinal section in the bone by means of a Hey's saw down to the medullary canal. In this way tension is taken off; and the pain, which appears to be dependent on the compression of the inflamed bone by its own condensed structure, is at once relieved. This means is especially applicable to osseous nodes on the tibia, and is a far less severe mode of treatment than trephining the bone, which has occasionally been adopted in such cases; while it is equally efficacious. After a time, when all morbid action ceases, the hypertrophied bone does not give rise to any very serious inconvenience, except such perhaps as may be occasioned by its bulk.

Osteitis is principally of importance to the surgeon from its connection with other more serious diseases of bones, in which it not unfrequently terminates. Those conditions are Suppuration of Bone, its Ulceration, Caries, and Necrosis.

SUPPURATION OF BONE.

Suppuration of Bone may present itself in two forms, the *Acute* and the *Chronic*.

ACUTE SUPPURATION: OSTEO-PYELITIS.—The acute form of suppuration is invariably of a diffused character. It usually arises as the result of injury inflicted on bones in compound fractures, gun-shot wounds, and operations; as, for instance, in amputations or in excision of joints. In it the medullary membrane is primarily affected, the inflammation rapidly extending through the whole of the medullary canal and adjoining cancellous structure, which speedily becomes filled with pus. Stanley observes that the medullary membrane in this disease becomes vascular like the conjunctiva in chemosis, and is often black and gangrenous (*Osteo-mycetitis*). This purulent infiltration of the interior of the bone is very apt to give rise to phlebitis and pyæmia, and hence becomes a most formidable affection, the pus finding its way into the veins of the bone, and thence into the general current of the circulation. Osteo-pyELITIS, phlebitis, and pyæmia, constitute a pathological sequence that is by no means an uncommon cause of death after operations implicating the medullary canal. When the diploe of the skull is affected, the sinuses and cerebral veins may be found after death highly inflamed and

filled with pus. In a case in which I excised the elbow-joint, the patient died of pyæmia; after death the interior of the humerus was found to be inflamed and filled with pus, and the axillary vein in a state of suppuration (Fig. 223).

The invasion of this disease, after an operation, is indicated by great and deeply seated pain, with much swelling, tension, cedema, and general redness of the limb or stump. The wound becomes sloughy, all discharge from it ceasing; rigors occur; and the symptoms of pyæmia speedily set in.

The Treatment consists in supporting the patient's constitutional powers by a tonic and stimulating regimen, and by scrupulous attention to hygienic rules.

So far as the affected bone is concerned, nothing can be done to it except its complete removal. Any operation performed upon the continuity of a bone affected with diffuse suppuration in its medullary canal is utterly inadmissible; the injury inflicted by the saw setting up great inflammatory action, and developing the disease in the part of the bone which is left. Hence, if secondary amputation of an injured limb should be rendered necessary, the bone being affected with osteo-mylitis, the operation should be performed at some joint above the injured and diseased bone. M. J. Roux has especially pointed attention to this important practical fact, and recommends as the result of his very extensive experience in the Italian war, that disarticulation of the injured bone should be performed in preference to amputation through its continuity. By the adoption of this practice he has successfully disarticulated the thigh at the hip-joint, in four cases of osteo-mylitis consequent on gunshot injuries of the lower end of the femur. Of 22 cases in which he performed secondary disarticulation of other joints for osteo-mylitis, all recovered; whereas every soldier died, whose limb was secondarily amputated through the continuity of the injured bone after the battles of Magenta, Montebello, Marignano, and Solferino.

CHRONIC SUPPURATION.—The more chronic form of suppuration of bone usually assumes a circumscribed character, and leads to the formation of abscess. The abscesses are usually met with in the cancellated structure, and occur with especial frequency in the head and lower end of the tibia. In some instances they are tolerably rapid in their formation, but in the majority of cases are excessively chronic. When of a more acute character, they are probably the result of the softening of tubercle previously deposited in the bone; and, forming in the cancellous structure, are very apt to undermine the contiguous cartilage of incrustation, and eventually to burst into the neighbouring joint (Fig. 224). When of a more chronic character, they are usually of very small size, and are deeply seated in the substance of the head, or in the medullary canal of the bone; the osseous substance covering them, having long been the seat of chronic inflammation, becomes greatly thickened and indurated. Most commonly the quantity of pus contained in these abscesses is extremely small, and it is often mixed



Fig. 223.—Diffuse Suppuration of Humerus.



Fig. 224.—Abscess in the Head of the Tibia.

with cheesy or tuberculous matter, or contains portions of necrosed bone intermingled with it. In some cases, however, Stanley has observed that abscesses of bone are large, containing a considerable quantity of fluid.

The *Symptoms* of chronic abscess of bone are usually of the following character. The patient, after the receipt of an injury, perhaps, has noticed that at one spot the affected bone has become swollen and painful; the skin covering it preserves its natural colour in the majority of cases, but in some instances becomes red, glazed, and cedematous; the pain, which is of a lancinating and aching character, is usually remittent, often ceasing for days, weeks, or months, and then returning, under the influence of very trivial causes, with its original severity. It is especially troublesome at night, and is always associated with a degree of tenderness of the part; and indeed, in the intervals of its accession, it will be found on careful examination that there is always one tender spot in the enlarged and indurated bone. The long persistence, for years perhaps, of these signs will usually point to the existence of a small circumscribed abscess under the thickened wall of the bone. But it must be borne in mind that the same local symptoms may be induced by three other conditions: 1, by the inclusion of a small portion of dead bone within a dense and impervious casing; 2, by the pressure of the osseous structures, greatly thickened and condensed by chronic inflammation; and, 3, by the expansion of the bone by an intracystic growth. For all practical purposes the diagnosis is of little consequence, as the treatment is the same, whether the pain and other symptoms arise from the confinement of a few drops of pus, from the inclusion of necrosed bone, from the pressure of hypertrophied osseous tissue, or from cystic disease.



Fig. 223.—Bone Trephine.

Treatment.—As a circumscribed abscess in bone cannot perforate the dense osseous structure overlying it by any process analogous to the pointing and discharge of an abscess in the soft parts, it becomes necessary for the surgeon to open up a vent for the pus. The proper way of doing this has been pointed out by Quasnay and Brodie. It consists in trephining the bone, so as to make an aperture for the exit of the pus, with an instrument having a small crown, of the size represented at *a*, Fig. 225. So soon as a vent has been given to the pus, which is often cheesy and occasionally very offensive in its character, the patient will experience great and permanent relief. In performing this operation, there are several points that deserve special attention. The bone must be exposed by a T- or V-shaped incision, made over the spot which has been found to be uniformly tender on pressure; and to this the trephine should be applied. The trephine should have a small and deep crown of the size and shape represented in Fig. 225; and it is well always to be provided with two instruments of the same shape and size that will exactly fit the same hole, lest one become disabled by the density and hardness of the osseous case, as I have seen happen. When the trephine has penetrated to a sufficient depth, the button of bone may be removed by means of an elevator; but care should be taken not to perforate the whole thickness of the bone. The diseased cavity will very commonly at once be opened in this way, a small quantity of pus escaping, which may, however, readily be overlooked, as it is carried away in streaks with the blood, which flows freely from the cut bone. Should no pus escape, perhaps a portion of dead

bone, or some dark gritty masses of disorganised osseous tissue, are exposed ; if so, they must be removed with a gouge. But if neither of these conditions be found, the surgeon must not be disappointed, but pierce the neighbouring osseous tissue in different directions by means of a perforator, when perhaps the abscess will be opened ; should it not be so, the patient will still in all probability be materially benefited by the removal of the circle of bone, and the consequent relief to the compression of the osseous tissue. After the operation, the cavity left must be dressed from the bottom with wet lint, and a poultice be afterwards applied ; it will gradually fill up with fibrous tissue, leaving the limb unimpaired in utility and strength.

CARIES.

By *Caries* some surgeons mean a kind of ulceration of bone ; others, a species of disintegration of the osseous tissue ; and Stanley includes under this term the various changes consequent on chronic suppuration of the cancellous structure. But caries, I think, properly means a disease of the bone, characterised by increased vascularity, softening, and ultimate disintegration of the osseous tissue. It appears to consist in a breaking down of the organised portion of the bone, in consequence of which the earthy matters become eliminated in a granular, molecular, and almost diffuent form in the pus formed by the inflammation of the surrounding more healthy structures.

STRUCTURE.—On examining a portion of carious bone, it will be found to be porous and fragile, of a gray, brown, or blackish colour ; partly broken down in softened masses, and partly hollowed out into cells, which contain a reddish brown and oily fluid. The process of wasting which goes on in the bone, appears to be partly the result of ulceration, and partly of disintegration of its tissue. In many cases, small masses of dead bone lie loose and detached in the carious cavity. Around this carious portion, the bone, as well as the medullary and periosteal membranes, are usually extremely vascular, and, in many cases, hardened compact masses of osseous tissue will be found deposited around the carious cavity, or even forming its exterior wall. These changes are most commonly met with in the cancellous structure, but the compact tissue may likewise be affected. As caries frequently occurs in the cancellated tissue, it is commonly met with in the heads of bones ; and here the disease is extremely dangerous, being apt to undermine and destroy the contiguous articular cartilage, and thus implicate the joint. This caries of the articular ends of bones is consequently a most serious affection, and is a very frequent cause of incurable joint-disease, such as suppuration and destruction of cartilage, followed perhaps by partial ankylosis. Any bone may be affected by caries, but it is perhaps more frequently met with in the short and cancellous bones.

CAUSES.—Caries usually occurs in constitutions that have been debilitated by struma or syphilis, often without any other apparent cause. Caries occurring in *strumous constitutions*, and affecting the short bones, as those of the tarsus, or the cancellated heads of the long bones, as the tibia, usually, if not always, commences in the centre of the bone, which becomes congested, softened, and disintegrated ; in many cases without any external cause, but apparently simply from the diminution of vitality in those parts of the osseous structure which are farthest from the periosteum, and which do not, like the deeper structures of a long bone, receive a supply of blood from an internal or medullary membrane. In these cases, the inflammation of the soft investing parts, and the destruction of the joint, which usually ensue, are consecutive to the disease in the bone.

In *sypilitic constitutions* caries is apt to affect the surface of the bone, disintegrating and eroding this in a remarkable manner. This condition has been described by Stanley as true *ulceration of bone*, and he regards it as distinct from caries, and analogous to ulcers of the soft parts. Here the disease does not penetrate deeply, but leaves the surface rough and porous, with a good deal of inflammation in the soft parts around the affected bone. He states that it only occurs in adults, and in males, and is very chronic in its character; it is met with primarily in the bones of the spine, but also occurs on the articular surfaces in advanced stages of joint-disease.

SYMPTOMS.—The symptoms indicative of the occurrence of caries are of a very equivocal character, and are not unfrequently, in the early stages, mistaken for those of ordinary phlegmonous abscess or rheumatism. They consist of pain in the bone, with a good deal of redness and swelling in the soft tissues covering it; abscess at last forms, often of considerable size, and, on letting out the pus, the character of the disease will be recognised, as the bare and rough bone may be felt with a probe, which sinks into depressions upon its surface, which, though rough, yields readily to the pressure of the instrument. The cavity of the abscess gradually contracts, leaving fistulous openings, which discharge a fetid pus, usually dark and sanious, intermixed with granules of bone, and containing a superabundance of the phosphates. The fistulous openings are generally surrounded or concealed by lugh spongy granulations, and the neighbouring skin is duskiy indamed.

TREATMENT.—The treatment of caries must be conducted in reference to the constitutional cause that occasions it, the removal of which is the first and most essential element in effecting a cure. If it arise from *sypilis*, this must be eradicated; if from struma, the general health must be improved. By the removal of causes such as these, the disease will often cease spontaneously, and even undergo cure, more especially in young subjects. Hence, it is well not to be in too great a hurry to interfere, by operative means, in the caries of the small bones of children. I have often seen cases, especially of caries of the bones of the hands and feet, in which an operation for the removal of carious bone was apparently indispensable, recover spontaneously on change of air, and attention to the general health of the child; the disintegrated particles of the diseased bone being eliminated piecemeal.

In the first stage of caries, which is inflammatory, measures should be taken, by means of appropriate local and constitutional antiphlogistics, to subdue the activity and limit the extension of the disease; and when this has fallen into a chronic stage, constitutional alteratives should be employed. Amongst these, cod liver oil, the iodulca, and change of air, more especially to the seaside, when the patient is young, should hold the first place.

Counter-irritation is of little avail in these cases in arresting the progress of morbid action. By means of blisters, iodine, and issues, thickening of the periosteum and of the soft structures covering the diseased patch of bone may be lessened, and pain subdued; but the real progress of osseous disease cannot, I think, be influenced by such means, when once it has passed the earliest stage of inflammatory congestion.

When the disease has fallen into a chronic condition, and nature seems unable to eliminate the carious bone, all reparative action having ceased, or being inefficient for the restoration of the integrity of the part, an operation becomes necessary. When the operative procedure has reference to the diseased part itself, it is impossible to be too careful in delaying it until the acute stage of the disease has passed, and the inflammation in the bone and surrounding tissues has subsided into a chronic state. Unless this be done, the excited action set up by the operation will unfaili-ly

give fresh impetus to the disease, which will make more rapid progress, and may perhaps terminate in diffuse suppuration of the bone.

OPERATIONS.—The operations practised upon carious bones are of four kinds; consisting either in simple Removal of the Diseased Portion of Bone; in Excision of the Carious Articular End; in Resection of the whole of the Bone affected; or in Amputation of the whole Limb.

The removal of the carious portion of bone is best effected by means of the gouge. This instrument is especially useful in those cases in which short, thick bones, or the articular ends of the long bones, are affected, without the neighbouring joints being implicated. In applying the gouge, the diseased portion of bone should be exposed by a crucial incision, and, if necessary, its cavity opened by a small trephine. The gouge, fixed in a short round handle, is then freely applied, and the diseased tissues are scooped and cut out. In order to do this efficiently, it is desirable to be furnished with instruments of different shapes and sizes, so that there may be no difficulty in hollowing or cutting away every portion of bone that is implicated. I have found the *gouge-forceps* (Fig. 232, p. 716), a very useful addition to the gouge in clearing away angular fragments and projections of bone, and thus removing the whole of the diseased structures. In some cases Marshall's *osteotrite* (Fig. 236) will be found a very serviceable instrument, clearing away the softened carious bone without risk to the surrounding healthy structures.

In removing the carious bone with these instruments, the surgeon may be sometimes at a loss to know when he has cut away enough. In this he may generally be guided by the difference of texture between the diseased and healthy bone; the former cutting soft and gritty, readily yielding before the instrument, whilst the latter is hard and resistant; so that, when all the disease is removed, the walls of the cavity left will be felt to be compact and smooth. In some cases, the healthy bone may have been softened by inflammation; should there be any doubt as to the condition of what has been gouged out, it may be solved by putting the *détritus* into water, when, if carious, it will either wash white or black: whereas, if healthy, but inflamed, it will preserve its red tint. In operating on young children especially, it is well not to have the gouge too sharp, lest the undrained, but otherwise healthy though somewhat softened bone, be cut away together with the disintegrated caries. The cavity that is left should be lightly dressed from the bottom, and allowed to heal by granulation, when it will gradually fill up by the deposition of fibrous material in it.

When caries affects the articular ends of the bones, as those that enter into the formation of the elbow or shoulder joints, it may be so situated as not to admit of removal in the way just indicated, but to require *excision* of the diseased articulation: this operation we shall consider in a subsequent chapter. When caries involves a bone so extensively that neither of the preceding plans can successfully be put into operation, it becomes necessary to perform either the *resection* of the whole of the bone, if it be of small size, or *amputation* of the limb, if of greater magnitude or if the neighbouring joints be extensively affected. Thus, for instance, resection of the os calcis may be required for caries of that bone; while, if the whole of the tarsus be affected, amputation is the only resource.



Fig. 236.—Marshall's Osteotrite.

NECROSIS.

The transition from Caries to *Necrosis* is easy. Caries may be regarded as the granular disintegration or molecular death of the osseous tissue, conjoined with suppuration of the surrounding healthy parts; whilst necrosis must be looked upon as the death of the osseous tissue as a whole—a condition, indeed, closely resembling that of gangrene of the soft parts. Whilst caries, however, chiefly affects the cancellous structure, necrosis is met with in the compact tissue of bone, and far more frequently occurs in the shafts than in the articular ends of the long bones. It is, however, occasionally found in the cancellous structure; thus in the head of the tibia, or in the os calcis, small masses of necrosed bone are not unfrequently found lying in the midst of carious or suppurating cavities. Different bones are affected by necrosis, with varying degrees of frequency. The tibia at its anterior part is most frequently diseased; the femur in its lower third is also very commonly affected. The lower end of the humerus is not so often necrosed; but not uncommonly the phalanges of the fingers from whitlow, the skull from syphilis, the lower jaw from the emanations evolved in the manufacture of phosphorus matches, and the clavicle and ulna from injury or constitutional causes, are found affected by necrosis.

CAUSES.—The causes of necrosis are of very various character. We have just seen that it is *Predisposed* to by the structure of particular parts of bone, and is more frequent in some bones than in others. Among the more constitutional causes, we may rank in the first line those cachectic conditions of the system that result from scrofula and syphilis, and those debilitated states of constitution that so frequently follow upon typhoid fever: in these various states, the bone may suddenly lose its vitality, more especially if the limb be subjected to slight accident, as concussion, or to exposure to some degree of cold. Sometimes the disease results from the vitality of the bone being destroyed by the extension of inflammation to it from the neighbouring tissues, as in some cases of whitlow, or by the bone becoming exposed by a neighbouring abscess.

Traumatic causes frequently give rise to necrosis. Thus the denudation of a bone by its periosteum being stripped off, may lead to its death; but, though the bone thus injured often loses its vitality, yet, if the membrane be replaced, its life may be preserved; even when it is exposed, adhesions may take place between it and the neighbouring soft parts, or granulations may be thrown out by its surface, which eventually form another periosteum. Necrosis frequently occurs as the result of the detachment and denudation of a portion of bone in cases of bad compound fracture, so also the application of certain irritants, as the fumes of phosphorus, may occasion this disease, and hence it has been found that, in lucifer-match manufactories, necrosis of the lower jaw is a frequent consequence of the acid fumes that are eliminated gaining access to the bone through carious teeth, or being applied to the exposed alveoli.

CHARACTERS.—In whatever way it originates, necrosis may affect the outer laminae only of the bone, when it may be called *peripheral*; or the innermost layers that surround the medullary canal may perish, and then it may be termed *central*; or the whole thickness of a shaft, or of the substance of a short bone, may lose its vitality. The necrosed portion of bone, called the *Sequestrum*, presents peculiar characters, by which its nature may at once be recognised. It is of a dirty yellowish-white colour, and has a dull opaque look, and, after exposure to the air, it gradually becomes of a deep brown or black tint; the margins are ragged, and more or less spiculated,

and the free surface is tolerably smooth, but its attached surface is very irregular, rough, and uneven, presenting an eroded or worm-eaten appearance. When the sequestrum forms in the cancellous structure, it is usually of a blackish-grey colour, irregular but somewhat ovoid in shape, as if the bony matter had been partially dissolved away, and here is frequently conjoined with caries of the surrounding bone.

SYMPTOMS.—The symptoms of necrosis are divisible into two distinct periods. In the first, the bone dies and undergoes separation, and an attempt is made by nature at the expulsion of that portion of it which has lost its vitality. In the second period, the reparative processes for the restoration of the proper length and shape of the shaft are carried on. The particular character of the symptoms depends, however, not only on the stage, but also in a great measure on the seat and extent of the necrosis. In all cases it is ushered in by symptoms of local inflammation of a more or less intense and painful character; the skin becomes glazed, cedematous, and of a purplish-red tint; abscess, often of large size, and discharging great quantities of fetid or bloody pus, forms in the limb, and burrows widely, in proportion to the extent of the necrosis, amongst its cellular planes. If the suppuration be not so extensive as to jeopardise life, as occasionally happens when the thigh is the seat of disease, the patient sinking into rapid hectic, the suppurating cavity will gradually contract, leaving fistulous and sinuous tracts, often of great length and extent, leading to rough and bare bone, discharging a fetid and ichorous pus, and having their orifices surrounded by protuberant and glazed granulations. All these symptoms of inflammation, abscess, and widely spread suppuration, have for their ultimate objects the separation and elimination of the dead bone, and the proper formation of new bone as a substitute for that which has died. They are in the first instance occasioned by, and are not the cause of, the death of the bone. When a bone or a portion of a bone necroses, it becomes to all intents a foreign body. The soft tissues around resent its presence, and endeavour to throw it off by an inflammatory action, just as they would if any extraneous substance, as a piece of wood, were thrust in amongst them. But the ultimate result of the action thus set up is not limited to the separation of the dead bone, but extends to the formation of material destined to repair the loss of substance occasioned by the separation and exclusion of the dead bone.

In *peripheral necrosis* of the shafts of the long bones, as of the femur or tibia, the inflammatory symptoms just indicated are well marked, and the disease usually runs a rapid course up to the period of the formation and discharge of the abscess. In the case of *central necrosis*, the pain is usually more severe than in the former case, and is peculiarly deep-seated and throbbing, being especially intense at night. The limb becomes very cedematous, red, and glazed; the bone enlarges greatly, and abscess at last forms, which spreads widely in the planes of cellular tissue, undermining the muscles, and producing general destruction of the limb, the tissues of which become rigid and condensed, having sinuses leading down through them. On introducing a probe into these channels, the instrument passes through apertures in the bony case, termed *Cloaca* (Fig. 227), at the bottom of which the dead bone will be felt rough and bare. Though this is the general condition that occurs in central necrosis, it occasionally but rarely happens that a small portion of some of the internal lamellae of the bone dies, and, being included in a greatly thickened case of new bone, gives rise to symptoms of osteitis, or closely resembling those of circumscribed abscess of bone, but not to those characterising necrosis.

When the whole thickness of a shaft dies, the symptoms are always of a

also, of the limb generally, if thick, as in the thigh, contribute to the formation of plastic matter, which gradually ossifies, and so tends to strengthen the new case; and, lastly, the articular ends of the old bone, still preserving their vitality, constitute most important agents in the reparative process, throwing out sufficient osseous matter to connect themselves firmly to the new shaft that is formed. Thus it will be seen that the new bone is formed by the vascular and healthy tissues generally that surround the seat of disease, though in this reparative action the periosteum and medullary membrane take the chief share. In acute necrosis there is no time for reparative action to take place; but the periosteum is found much thickened and vascular, separated from the dead bone and occasionally lined with scales of new osseous matter, the first step toward the reproduction of a new shaft.

The new bone deposited on those parts of the surface of the shaft from which scales of the old osseous tissue have been separated, or enveloping the sequestrum when the whole thickness of the shaft becomes necrosed, is at first rough, porous, cancellated, and very vascular; after a time it gradually becomes more compact and harder, at the same time that it assumes a bulk and shape to the bone whose place it takes. The case of new bone, which necessarily exceeds in circumference the old bone, as this is increased within it, gradually contracts both in texture and in size, becoming firmer and smaller after the removal of the sequestrum, and the cloaca closing so soon as all dead bone has been extruded, it eventually acquires the proper size and shape of the bone; the medullary canal even becoming lined with a proper membrane forming in it. In this way, regeneration of the whole of the shaft of many of the long bones, such as those of the arm, forearm, and leg, will take place, provided always the epiphyses have been untouched by disease. If one or other of these has been destroyed, all power of repair seems to be lost.

The new bone usually forms with a rapidity that keeps pace with the death and separation of the old bone. In acute cases of necrosis, in which amputation has been performed but a few weeks after the setting in of the disease, a thick layer of new bone will sometimes be found under the periosteum; but in some instances, when the whole of a shaft is necrosed, the new case is not completed, or has not become attached to the articular ends before these are separated from the shaft. In other cases, though complete, it has not sufficient strength to resist the contractions of the muscles of the limb; under these circumstances, it may spontaneously fracture—as happened in a case of necrosis of the thigh under my care in the Hospital—or become shortened or bent. In other instances, again, when the periosteum is deficient, new bone does not form (Fig. 228), but, as the sequestrum separates, the limb becomes shortened, loose, deformed, and useless.

Fig. 228.—Necrosis. Deficient formation of New Bone.

TREATMENT.—In the treatment of necrosis, the indications to be accomplished are sufficiently simple, though the mode in which they have to be carried out often requires much patience and skill on the part of the surgeon.

The first point to be attended to is to remove any constitutional cause.

cause that has occasioned or keeps up the disease ; unless this be done, it is clear that the whole of the rest of the treatment must be ineffectual. Thus, for instance, if the death of the bone appear to result from scrofula or syphilis, those conditions must be corrected. So, again, if it arise in the lower jaw from the fumes of phosphorus, the patient must necessarily be removed from their influence ; or, if it be threatened in consequence of accumulation of bone, the best mode of prevention will be to lay down the flap of integument, and so cover the exposed surface. Abscess should be opened as soon as it has fairly formed. The early and free opening of purulent collections is especially imperative when they are *sub-periosteal*. In these cases the constitutional irritation occasioned by the confined pus is often so intense, more particularly in children of feeble constitutions, that life is threatened, and can only be preserved by the evacuation of the pus from the midst of the tense structures between which it lies.

Removal of the Sequestrum.—After the cause has, in this way, been removed or counteracted, the separation of the sequestrum should be left as much as possible to the unaided efforts of nature. The less the surgeon interferes with this part of the process the better ; for, as has been justly observed by Wedemeyer, the boundaries of the necrosis are known to nature only, and the surgeon will most probably either not reach, or he will pass altogether beyond them. Here much patience will be required for many weeks or months ; and the utmost that the surgeon can do is to attend to the state of the patient's health, treating him carefully upon general principles, removing inflammatory mischief by appropriate antiphlogistic means, opening abscesses as they form in the limb, and at a later period, supporting the patient's strength by good diet, tonics, and general treatment, calculated to bear him up against the depressing and wasting influence of continued suppuration, and of the irritation induced by the disease.

So soon as a sequestrum has been detached from the adjacent or underlying bone, by the proper extension of the granulating line of separation, the surgeon must proceed to its removal. In most cases it is sufficiently easy, when the necrosis is superficial, to ascertain that this separation has taken place, as the flat end of a probe may be pushed under the edge of the detached lamina. When, however, the sequestrum is deeply seated, it is not always so easy to ascertain that the separation has occurred ; though, in the majority of cases, the introduction of a probe through one of the fistulous openings leading to the necrosed bone, and firm pressure exercised upon this, will enable the surgeon to detect that degree of mobility which is characteristic of looseness. In other cases, however, the sequestrum, though completely removed from all osseous connections, still continues to be fixed by the pressure of the surrounding granulations, and by the extension of its spicula into the corresponding cavities of the new osseous case. This especially happens when the sequestrum is central and invaginated, and the cloacæ leading to it of such small size that but a limited portion of it is exposed. Here a more careful examination will be required ; and its looseness may sometimes be determined by pressing upon it with a probe in a kind of jerking manner, or by introducing two probes through different cloacæ, at some distance from one another, and alternately bearing upon the exposed bone with one or other of them. Then, again, if the sound elicited by striking the end of the probe against the sequestrum be a peculiarly hollow one, the detachment of the bone may be suspected. The duration of the disease, also, will probably throw some light upon the probable state of things inside the new case.

The separation of the sequestrum having been ascertained, the surgeon

also, of the limb generally, if thick, as in the thigh, contribute to the formation of plastic matter, which gradually ossifies, and so tends to strengthen the new case; and, lastly, the articular ends of the old bone, still preserving their vitality, constitute most important agents in the reparative process, throwing out sufficient osseous matter to consolidate themselves firmly to the new shaft that is formed. Thus it will be seen that the new bone is formed by the vascular and healthy tissues generally that surround the seat of disease, though in this reparative action the periosteum and medullary membrane take the chief share. In acute necrosis there is no time for reparative action to take place; but the periosteum will be found much thickened and vascular, separated from the dead bone, and occasionally lined with scales of new osseous matter, the first step towards the reproduction of a new shaft.

The new bone deposited on those parts of the surface of the shaft from which scales of the old osseous tissue have been separated, or enveloping the sequestrum when the whole thickness of the shaft becomes necrosed, is at first rough, porous, cancellated, and very vascular; after a time it gradually becomes more compact and harder, at the same time that it assimilates in bulk and shape to the bone whose place it takes. The case of new bone, which necessarily exceeds in circumference the old bone, as this is included within it, gradually contracts both in texture and in size, becoming firmer

and smaller after the removal of the sequestrum; and, the cloacæ closing so soon as all dead bone has been extruded, it eventually acquires the proper size and shape of the bone; the medullary canal even becoming lined by a proper membrane forming in it. In this way, restoration of the whole of the shaft of many of the long bones, such as those of the arm, forearm, and leg, will take place, provided always the epiphyses have been left untouched by disease. If one or other of these have been destroyed, all power of repair seems to be lost.

The new bone usually forms with a rapidity that keeps pace with the death and separation of the old bone. In acute cases of necrosis, in which amputation has been performed but a few weeks after the setting in of the disease, a thick layer of new bone will sometimes be found under the periosteum; but in some instances, when the whole of a shaft is necrosed, the new case is not completed, or has not become attached to the articular ends before these are separated from the shaft. In other cases, though complete, it has not sufficient strength to resist the contractions of the muscles of the limb; under these circumstances, it may spontaneously fracture—as happened in a case of necrosis of the thigh under my care in the Hospital—or become shortened or bent. In other instances, again, when the periosteum is deficient, new bone does not form (Fig 328); but, as the sequestrum separates, the limb becomes shortened, loose, deformed, and useless.

Fig 328.—Necrosis Deficient Formation of New Bone.

TREATMENT.—In the treatment of necrosis, the indications to be accomplished are sufficiently simple, though the mode in which they have to be carried out often requires much patience and skill on the part of the surgeon.

The first point to be attended to is to remove any constitutional or local



ever, should be taken not to remove more of the new case than is absolutely necessary, as the aperture so made in it will not be filled up again by osseous matter, but will be closed by fibrous tissue, and thus the ultimate soundness of the limb might be endangered. For the extraction of the sequestrum, the most convenient instrument is a pair of strong necrosis-forceps, well roughened at their extremity, and straight or bent as the case may require (Fig. 234). Occasionally the sequestrum is so shaped and placed that it cannot be seized with this instrument; under these circumstances, it will be



Fig. 234.—Necrosis Forceps.

useful to drive a screw-probe (Fig. 57) into it, by which it may either be extracted, or so fixed as to admit of seizure and removal by the forceps. In some cases, additional and convenient purchase may be given to the dead bone, by fixing a bone forceps, such as is represented in Fig. 235, firmly into



Fig. 235.—Bone-Forceps.

it. If the sequestrum be too large to be removed entire through the cloaca, it may perhaps best be extracted piecemeal, having been previously divided by passing the points of narrow but strong cutting pliers into the interior of the bone.

After the removal of the sequestrum, a smooth hollow cavity will be left in the new case, from the bottom and sides of which blood usually wells up freely, issuing abundantly from the vascular bone, and from the granulating membrane lining its interior. Should this hemorrhage be at all troublesome, pressure will always sufficiently arrest it. Lint must then be lightly introduced into the bottom of the wound, and the part elevated; a good deal of inflammation is frequently set up after the operation, but that must be combated on general principles. If the sequestrum have been a long one, and have involved the greater part of the shaft of the bone, it may happen that the new case has not sufficient strength to maintain the limb of its proper length and shape, and that it will bend or break under the action of the forces and weight to which it is subjected. In order to prevent this accident, it will be necessary to put it up in light splints, or in a starched bandage. After the removal of the dead bone, the fistulae will speedily close, and the limb eventually regain its normal size and shape.

must adopt measures for its extraction. If the necrosis be *peripheral*, all that is necessary is to make an incision down to it through the soft parts, either by directly cutting upon it or by slitting up sinuses with a probe-pointed bistoury, and then to remove it with a pair of forceps, or to tilt it off the bed of granulations on which it is lying, by introducing the end of an elevator beneath its edge.

When the necrosis is *central*, the sequestrum being imbedded in the new case, or covered in by old bone, the operative procedures for its removal are of a more complicated character. The difficulties here consist in some cases in the depth from the surface, and in the obstacle offered by its passage through the soft parts; and in others, in the length and magnitude of the sequestrum in proportion to the small size of the cloaca, and in the manner in which it lies, in a parallel direction to these openings. In cutting down upon the bone, the surgeon must be guided by the direction and the course of the fistulous tracks that lead to the principal apertures in the new case, the incisions being carried in the axis of the limb, and carefully directed away from large blood-vessels and nerves. In many instances, however, the hemorrhage is somewhat abundant, in consequence of the injected state of the tissues furnishing a copious supply of blood, and their rigid condition preventing retraction of the vessels; this, however, may be arrested by a tourniquet or by the pressure of an assistant's fingers, and will soon gradually cease of itself. The bone having been freely exposed, it will sometimes be found that the cloacae are of sufficient size to allow the ready extraction of the sequestrum. But in the majority of cases, this cannot be done at once, and the apertures must be enlarged, either with the gouge or the trephine, according to the density of the new case, and amount of room required. Occasionally, when two cloacae are close to one another, the intervening bridge of bone may very conveniently be removed by means of cutting pliers, of different shapes (as in Figs. 229, 230, and 231), or by



Fig. 229.



Fig. 230.



Fig. 231.

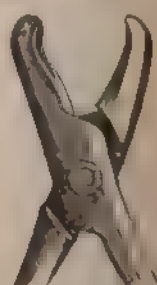


Fig. 232.—Gouge-forceps.

Cutting Pliers for removing Necrosed Bone.

means of a Hey's or a straight narrow saw (Fig. 233), and space thus given for the extraction of the sequestrum. Very convenient pliers for this purpose are those represented in Fig. 232. They are made by Mr. Coxeter,

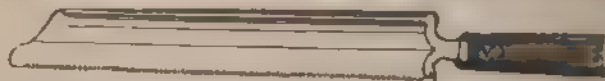


Fig. 233.—Straight Saw for removing Necrosed Bone.

with gouge ends, and hence may be termed *gouge-forceps*. I have found them extremely serviceable in many operations upon the bones. Case, how-

exposed for necrosis, as will be more fully mentioned when I come to speak of extension of the hip-joint. The tuber ischii, when affected, may readily be amputated.

NECROSIS OF THE CRANIAL BONES is of frequent occurrence as the result of struma or syphilis, or the two conditions conjoined. When met with in children, it is usually strumous, often occurring after measles or scarlet fever; in adults it is usually syphilitic, though by no means invariably so, being sometimes the result of blows in people of otherwise healthy constitutions. There are four situations in which necrosis of the cranial bones may occur, viz., in the vault of the skull, the frontal bone, the temporal bone, or in the sphenoid and ethmoid bones. When idiopathic necrosis affects the vault, it is usually syphilitic; when it occurs in the other situations, especially in the temporal bone, it is commonly strumous.

Two forms of necrosis affect the cranial bones. In one case the outer table is alone affected. this perishes, separates, and exfoliates; granulations then spring up from the outer surface of the inner table, and a process of repair is thus established. In the other form, the necrosis is hard, dry, rough, and pitted or worm-eaten, penetrating through the diploe to the inner table, separating very slowly, and lasting an indefinite period.

Results.—In necrosis of the cranial bones, there is always the special danger of extension of morbid action to the membranes of the brain, and the consequent occurrence of inflammatory effusion within the skull, leading to convulsions, coma, and death. This danger is greatest when the petrous portion of the temporal bone is affected, as the structure of this bone is homogeneous, and the dura mater is continuous with the lining of the cavities by which it is perforated. Cerebral complication is least likely to occur when the frontal bone is the seat of disease, more particularly the lower part of this bone, where, by the intervention of the frontal sinuses, the anterior wall is altogether carried away from the inner table, and from all dangerous proximity to the membranes of the brain.

The *Signs* of necrosis of the cranial bones are very obvious. When the vault or forehead is affected, there is tenderness, with some puffiness, and gradual elevation of the scalp into an abscess. When this is opened, the necrosed bone may be felt or seen lying, dry and dark, at the bottom of a sinus or unhealed ulcer. When the petrous portion of the temporal bone is the seat of disease, there will have been ear-ache, followed by profuse fetid discharge from the ear, with perforation of the tympanum, escape of the ossicula auditus, and deafness. When the sphenoid or the ethmoid is affected, deep pains in the head, persistent oedema of the eyelids, and fetid discharge from the nose, will reveal the nature and seat of the mischief.

The *Treatment* of necrosis of the cranial bones will vary according to the nature and the seat of the disease. In the dry pitted variety, exposing and scraping the diseased osseous surface will often bring about a healthy action, provided the disease have not penetrated too deeply. Should there be reason to think that the inner table has been perforated, it will probably be safer to leave the case to the reparative processes of nature than to trephine. If, however, the anterior wall of the frontal sinus be the seat of the disease, or if the supraorbital ridge be affected, the dry and rough bone may be safely removed, as I have on more than one occasion had to do, by the application of the trephine in the first instance, and of the gouge in the other case. When exfoliating necrosis of the outer table affects the vault of the skull, the loosened plate may readily be lifted off its granulating bed by means of the elevator or forceps, after it has been fairly exposed.

Necrosis of the petrous portion of the temporal is usually fatal from encephalitis. When the sphenoid or ethmoid are the seat of necrosis, little can usually be done by operative interference; though in the latter case portions of sequestrum may sometimes be extracted through the nostrils.

The PATELLA is rarely necrosed. I have, however, met with one instance of primary necrosis of this bone leading to disorganisation of the knee-joint, and necessitating amputation.

Ribs.—When the ribs are necrosed, abscesses and sinuses will often form to a considerable extent on the side of the chest. These must be laid open, and the diseased portion of bone scraped away by the gouge. In doing this, care must of course be taken that the adjacent intercostal space be not punctured by an unfortunate slip of the instrument—an accident that is best avoided by protecting the gouge well with the finger.

CHAPTER XLVII.

STRUCTURAL CHANGES IN BONE.

THE bones are liable to various structural changes, by which their size, shape, and consistence are modified, or in consequence of which they become the seat of tumours of various kinds.

HYPERTROPHY of bone usually results from inflammation of the osseous tissue, but in some cases it may occur apparently without having been preceded by any signs indicative of this condition; it then resembles in character some of the forms of exostosis that will presently be mentioned.

ATROPHY of bone occurs, as a natural result, in old age. In other cases it happens as a consequence of fracture; the nutritious artery of the bone having been torn across, and one of the fragments consequently receiving insufficient vascular supply. Atrophy of bone also commonly occurs from disuse, as is the case in old dislocations. In cases of hypertrophy, the bone is not only enlarged in circumference, and also perhaps in length, but is indurated, becoming specifically heavier. In atrophy, on the other hand, it is thinner, lighter, and more porous than usual, the compact structure disappearing, and the cancellous being expanded.

RICKETS, MOLLITIES OSSIUM, AND TUBERCLE.

RICKETS is a disease of early life, usually being met with in scrofulous children, and never occurring after the age of puberty. In it the structure of the bones is changed, the earthy matter being deficient, and the organic material in excess; so that the bone continues to be soft, flexible, and cartilaginous in structure, at an age when its tissue ought to have undergone proper consolidation. It appears to be atrophied, and the cancellous structure to be expanded into cells of varying magnitude, which contain a brownish-red serous fluid. In consequence of the change of structure and the loss of firmness in the bones in this disease, considerable distortion of the body takes place. The head early appears large and expanded, indeed, Kilian states that rickets always first appear in the head, the forehead being especially protuberant; according to Stanley, this arises not from enlargement of the cranial bones, but in consequence of the want of development of those of the face; the head thus appearing large from its dispro-

portion to the small face. The shape of the limbs is much changed and distorted, in consequence of their yielding to the pressure of the superincumbent weight; the pelvis becoming contracted, and the thighs and legs bent either forwards or outwards. The joints are usually swollen, the articular ends of the bones appearing enlarged. In early life the chest will be observed to be deformed in a peculiar manner, being narrowed above, where the upper ribs are contracted and pressed in, but expanded below, apparently from the weight of the abdominal viscera, which are often tumefied, and in these cases drag on the lower ribs. As puberty advances, lateral curvature of the spine commonly takes place. In rickety children there is a general delicacy of appearance, and often a strumous habit of body, though, according to Rokitsansky, they are not usually tuberculous; if they live, however, past the age of puberty, they may eventually become sufficiently powerful in frame.

The Treatment of rickets must be conducted on the same general principles that guide us in cases of scrofula; pure air, good food, and plenty of it, regular exercise, and the administration of tonics, especially the preparations of iron, with scrupulous attention to the general habits of life of the child, will generally improve his condition to the utmost limits compatible with the powers of his constitution, and will, by improving the nutrition of the system, tend to the more healthy deposition of osseous matter. In some cases, the administration of lime-water with milk seems to be of service in supplying those elements that are required by the system. It is of much importance in preventing deformity in these cases not to allow the child to walk or stand much, but to let it take exercise in doukey-panniers or hand-chairs, and to support those limbs that have a special tendency to become excurvated, with properly-constructed steel supports, which will be found of much use, provided they are not too heavy, or interfere with the action of the muscles. Methodical friction should also be employed, so as to stimulate the muscles; as these become more vigorous, their osseous attachments have a tendency to become stronger.

MOLLITIES AND FRAGILITAS OSSIUM—OSTEOMALACIA.—A very rare but most destructive and dangerous disease of the bones, characterised by softening and fragility of the osseous structure, is occasionally met with. This affection has of late years been studied with much attention by Curling, Solly, Stanley, MacIntyre, and Litzmann; and it is principally from their labours that we are acquainted with the principal facts relating to it.

In this disease the bones are bent, their epiphyses swollen, and their shafts broken in various parts of the body. Occasionally, though very rarely, only one is fractured; but in other cases, as in Tyrrell's, there may be as many as twenty-two fractures, or, as in Arnott's, thirty-one. These fractures are unattended by any attempt at the formation of callus. The body becomes angularly and distressingly distorted. On examining the bones after death they will be found to be light, soft, and somewhat gritty—ben ling, and at the same time readily snapping across; occasionally they are expanded and thickened. This happens especially with the skull, which becomes often considerably increased in substance. On cutting the bones, which are soft and yield something like cartilage, the knife usually encounters a kind of gritty sensation. On making a section of the bones they appear of a deep red lish-brown or maroon colour, and will be seen to contain cavities of various sizes, small or large, but always of a circular or oval shape, and generally filled with an oily, red, and grumous fluid, though sometimes they contain clear serum. On examining this red grumous matter under the microscope it shows a cell-development; hence Solly remarks that it is probably an adventitious

morbid product, and not simply fatty matter altered by the effusion of blood into it. Dalrymple has shown that this material is composed of granular matter, nucleated cells, and a few caudate corpuscles: he therefore believes it to be a disease essentially malignant in its nature, but differing from other malignant affections; for, "instead of progressively reproducing and developing themselves without limitation, the new and morbid formations which replace the original and sound structure seem to have been at an early stage of their existence removed by absorption and carried out of the system" (MacIntyre). The bone has been found by Solly, on microscopical examination, to have its laminated structure absorbed, the osseous corpuscles diminished in number, and the Haversian canals enormously distended.

In chemical composition, the diseased bone has been found by Dr. Leeson to be composed of 18.75 animal matter, 29.17 phosphate and carbonate of lime, and 52.08 of water in every hundred parts.

Cause—The cause of the complaint is obscure. It would appear that it is frequently connected with a rheumatic tendency; as, in every case recorded, the affection has been preceded or accompanied by severe pains, or distinct rheumatic attacks. In some instances the patients have been affected with syphilis. In a majority of the cases it appears to have a connection with the childbearing state. It most commonly, though not invariably, occurs in females, as pointed out by Kilian. Among 131 patients whose histories have been collected by Litzmann of Kiel, there were 85 females, in whom the disease either appeared during pregnancy and labour, or was modified in its course by these conditions. Of the remaining 46 patients, 35 were females and 11 males. It most generally attacks adults, having been observed in few cases under the age of 20; and it may occur even at very advanced age.

The *Seat of the Disease*, according to Litzmann, varies according as it occurs within the childbearing period, or independently of this. In 85 childbearing women, the whole skeleton was affected in 6 cases only, and all except the bones of the head in 2; while in 46 other cases, all parts of the skeleton were diseased in 21, and all the bones except those of the head in 6. The percentage of the occurrence of the disease in various parts is shown in the following table:—

	85 childbearing women	46 other cases
Pelvis	90	87
Spinal Column	54	87
Chest	31	80
Lower Limb	17	73
Upper Limb	12	62
Head	8	52

In childbearing women the disease appears to have a remarkable predilection for the pelvis, it is probable, however, that a careful examination of all the bones has not been made in all cases.

State of the Urine.—In all cases that have been recorded, the urine has been seen to contain large quantities of earthy matter. Solly pointed out that this is phosphate of lime, which has been absorbed from the bone, and thrown out by the kidneys in the urine; and sometimes the elimination of this matter is so abundant that it forms, as in one of the cases which he relates, a solid calculus clogging up the interior of the kidney. In Dr. MacIntyre's case, the earthy matters of the bone appear to have been, in the first instance, absorbed, and carried off from the kidneys by the urine; but afterwards an animal matter, of a peculiar and apparently previously undescribed character, was discharged in abundance.

Symptoms.—These are, in the early stages, extremely obscure and insidious. The patient complains, in the first instance, of wandering pains about the limbs and trunk; these assume usually a rheumatic character, though they have been observed to be of a much more severe, persistent, and intractable nature than in any form of rheumatism. The patient becomes debilitated, unfitted for exertion, and emaciated. Spontaneous fracture now occurs in some bones under the influence of the most trivial causes; others become bent, and the body consequently greatly misshapen and distorted. The urine presents some of the abnormal characters above described, and death eventually results from general exhaustion.

Diagnosis.—The diagnosis of this affection has to be made in the early stages from *rheumatism*. This is not always easy, and, indeed, is at first impossible; but after a time, when the peculiar phosphatic condition of the urine and the fragility or distortions of the osseous system manifest themselves, the true nature of the affection becomes apparent. From *rickets* the diagnosis may usually be pretty readily made, by observing that, whilst *rickets* is a disease of childhood, *osteomalacia* is peculiar to adult or advanced life. The severe pains and the great distortion, with the tendency to spontaneous fracture which is observed in this disease, are never noticed in rickety children.

Treatment.—With regard to treatment, but little can be done: the administration of tonics, and a general supporting plan of treatment, may arrest for a time the progress of this terrible affection; but when once it is declared, it usually progresses from bad to worse, and at last destroys the patient. Opiates may be employed to allay the pain, and in Dr. MacIntyre's case some temporary advantage appeared to result from the administration of alum; but no remedy has appeared to exercise any continuous advantage in this complaint, which there is reason to believe, with Solly, is truly malignant.

TUBERCLE OF BONE.—The deposit of tuberculous matter in bone plays an important part in many diseases of this tissue in children and young people of a scrofulous habit of body; being a common cause of some of the most intractable forms of chronic osteitis, circumscribed abscess, caries, and necrosis. As tubercle is almost invariably deposited in the cancellous structure, it is a frequent cause of those forms of inflammation of the articular extremities of long bones, that terminate in the destruction of the contiguous joint. In the short bones, as those of the tarsus, it commonly leads to caries and necrosis; and forming, as it often does, in the bodies of the vertebrae, it very frequently gives rise to some of the most destructive diseases of the spine, attended by the formation of large lumbar and iliac abscesses. When once tubercle has been deposited in a bone, it usually sets up a low form of inflammation in the surrounding osseous tissue, which rapidly runs into a carious condition, with the formation of curdy pus, in which masses of half-disintegrated tubercle may be seen. If this destructive action take place with great rapidity, portions of the bone will be found to necrose in small masses, which lie at the bottom of these tuberculous and carious cavities, as may commonly be observed in some forms of strumous caries of the os calcis and head of the tibia. These tuberculous vomica undermine the overlying articular cartilage, and thus opening up the interior, give rise to the most destructive suppurative disorganisation in it. Fig. 236 is a representation of one of these vomicae in the head of

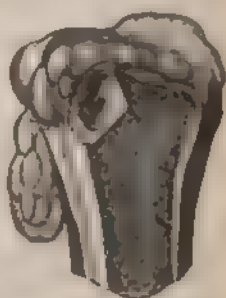


Fig. 236.—Tuberculous Vomica in Head of Tibia.

the tibia, their most common seat. When the tuberculous deposit has been very extensive, and is of a more acute character, it may cause inflammation and disintegration of the whole of the articular end of a long bone, with separation of the epiphysis. These destructive changes may take place with great rapidity; I have seen them happen in a lad, whose thigh I amputated for acute tuberculous infiltration of the lower end of the thigh-bone, in less than a month from the first occurrence of the complaint; the patient, at the time of the operation, being nearly exhausted by hectic, induced by the abundant discharge from the diseased bone, and from immense abscesses in his thigh.

When, on the contrary, the tuberculous matter is deposited in small quantity in an otherwise healthy bone, it may, as it undergoes softening, dispose to the occurrence of circumscribed abscess, at the same time that chronic thickening and condensation of the surrounding bone takes place. It is in consequence of this condensation of the peripheral portion of the bone by the deposit of fresh layers of osseous tissue under and by the inflamed periosteum, and the difficulty that the tuberculous abscess necessarily experiences in traversing the hypertrophied osseous structure, that it is so apt, when deposited in the vicinity of a joint, to work its way through the cartilages into the cavity of the articulation; as on this surface no fresh deposit nor condensation of osseous tissue can take place, and consequently no additional obstacle is offered to the onward progress of the tubercle, or rather of the curdy pus into which it has become transformed.

The presence of tubercle in osseous tissue thus not only gives rise to destructive changes in the bone and adjacent articulations, but will occasion inflammation and extensive suppuration in the neighbouring soft parts; indeed, some of the largest chronic abscesses that form in the body, those connected with diseased dorsal or lumbar vertebrae, owe their origin in the majority of cases to the deposition and disintegration of tubercle in the bones. When once tubercle in bone has given rise to caries and perforation of the osseous tissue covering it, together with plastic infiltration, and abscess and sinuses of the soft parts, these conditions will continue in a permanent manner; the fistulous tracks leading down to the bone, and the cavities in it, remaining open so long as any tuberculous matter is left at the bottom of them; and in this way the patient may eventually be exhausted by the copious and continuous discharge from the osseous vomicae. In some favourable cases as the result of natural processes, and in others by those operations that the surgeon practises for caries, the whole of the tuberculous matter may be disintegrated, and thus eventually eliminated, a true vomica being left in the bone, or scooped out by the gouge; and then the fistulous track, whether in the soft parts or in bone, having no longer this kind of foreign body lying on its bottom, will gradually close—not by the contraction of its osseous walls, which is of course impossible, but by the deposition of a fibrous tissue by which the cavity is occluded.

Pathology.—Nélaton has pointed special attention to the pathology of tubercle of bone, and to the important part that it plays in the diseases of the osseous structure. He describes two forms of tubercle in this situation; the first is the *encysted* variety, which occurs in the form of small masses, of an opaque white or yellowish colour, contained in a cyst, which is soft, vascular and spongy, apparently of a cellular structure. This variety is stated by Nélaton to be the most common. I have certainly not found it so, but have most frequently met with the infiltrated opaque tubercle. The other form in which tubercle occurs, according to Nélaton, is an *infiltration* into the cancellous structure of bones. This may be in the form of

semi-transparent granulations of a greyish or rosy tint, opalescent and slightly transparent, occasionally these granulations are firm, so as almost to resemble cartilaginous deposits in the interior of the bone. The osseous structure, in the midst of which this kind of tuberculous matter is deposited, does not appear at first to undergo any material alteration. Tubercle may also be infiltrated as opaque puriform matter of a pale yellow colour, soft, and without vascularity (Figs. 237, 238). The osseous tissue, under the



Fig. 237.—Tuberculous Head of Tibia.

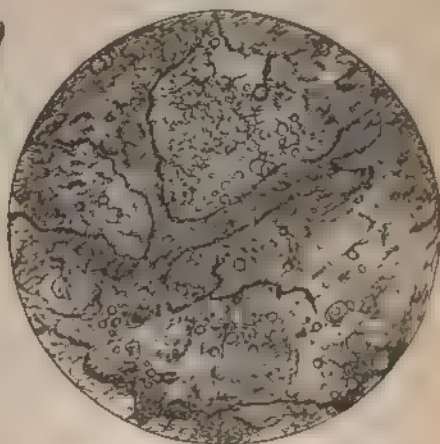


Fig. 238.—Tuberculous Bone magnified 2.0 Diameters.

influence of this disease, often becomes, as Nelaton observes, more condensed than natural, the cells being obliterated so as to resemble the compact substance of bone. In some cases it may continue thus chronically thickened and indurated; but in other instances the tuberculous inflammation will give rise to rapid and destructive inflammation of the surrounding osseous tissue, which becomes excessively vascular, and crumbles down into a crumbly state, with some necrosed masses intermixed. In other instances, as is not unfrequently observed in some of the forms of caries of the spine, or of white swelling, slow suppuration takes place in the interior of the bone; and on the sides or in the centre of the abscesses thus formed, hardened and white ivory-looking masses and knobs of osseous tissue may be seen to be deposited; these apparently consisting of tuberculous bone that has undergone some special modification of structure.

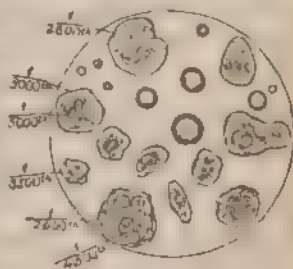


Fig. 239.—Cells of Osseous Tubercle

Treatment.—The treatment of tubercle of bone resolves itself into that of its effects. As its existence cannot be recognised except by the changes which it induces in the bone, the treatment must be directed exclusively to these. Thus, if it occasion circumscribed abscess, this must be opened; if caries, the diseased cavity and tissue must be scooped out, or removed in accordance with the principles already laid down; and if disease of the neigh-

bouring articulations result, it must be managed in the way that will hereafter be explained.

It is of importance, however, to recognise the dependence of these various affections on a tuberculous state of the bone; for, as this is always of a scrofulous character, it should necessarily occasion the constitutional measures that are employed to be specially directed to the removal of this cause. Thus good food, sea-air, the administration of iron, of the iodides, and cod-liver oil, will form most important elements in the treatment; and without these, indeed, it cannot be brought to a successful termination. The progress of these cases is generally excessively tedious. Stanley gives, indeed, two years as the time required for a strumous bone to recover itself; and in very many instances this period may even be exceeded. In this, as in all other of the chronic inflammatory affections of the bone, it is of considerable moment to continue the means of cure until the disease is fully recovered from; for relapse will occur with special readiness in the tubercular affections, if the patient be allowed to use the diseased limb or part too soon.

TUMOURS OF BONE.

Exostosis.—By exostosis is meant the growth of a bony tumour from some of the osseous structures of the body. The causes that immediately give rise to this disease are usually extremely obscure. There can be no doubt that, in some instances, it is predisposed to by syphilis, scrofula, or cancerous affections; and that in other cases, again, it is hereditary; but, in general, it occurs without any distinct or appreciable exciting cause. It chiefly occurs in the young, developing itself about the age of puberty. Exostosis appears to originate in two ways; being either primarily formed and deposited as true bone, or in other cases being the result of the ossification of an enchondroma.

Exostoses are of two kinds—the one hard and compact, the other softer and more spongy. The hard, or *Ivory Exostosis*, is a structure that differs both in appearance and composition from true bone. It is extremely compact and white, having a granular section closely resembling that of ivory, and presenting somewhat radiating fibres. In chemical composition, it is found to differ from healthy bone in containing more of the phosphate and less of the carbonate of lime, and also in the proportion of animal matters being smaller. This kind of exostosis principally grows from the flat bones, and, as it is generally of small size, seldom produces much inconvenience, unless it project into and compress important parts. Thus, Oloquet relates the case of a tumour of this kind growing from the pubic bone, and perforating the bladder; and it is occasionally found to project into the orbit, or from the inner table of the skull, upon the brain. When exostosis is left to itself, it becomes stationary after a time. In some instances it has been known to necrose, and to slough away, as it were, from the parts in which it has been situated. Of this termination Hilton and Boyer relate instances.

The *Spongy, Cancellous, or Cellular Exostoses* grow rapidly, often attain a considerable size, and are very commonly multiple. It is this form that is usually primarily enchondromatous. When numerous, they will often be found to be somewhat symmetrical in their arrangement. Not unfrequently they stretch across from one bone to another, bridging over joints, and thus giving rise to ankylosis; in shape they vary greatly, sometimes being globular, at others spinnous; in structure and chemical composition they are identical with cancellated bone.

The *Symptoms* of exostosis are simply those produced by a hard, thick,

and slowly growing tumour, connected with a bone and pushing forwards the soft parts covering it. In many cases, it produces serious inconvenience by its pressure, either upon neighbouring organs or mucous canals; or it may occasion ulceration of the skin lying above it.

Treatment.—If an exostosis be so situated as to occasion inconvenience or deformity, it will be necessary to remove it; and as it is a local disease, there is no fear of its return, provided this be fully done. If, however, the whole of it be not taken away, it may grow again; and Stanley accordingly recommends that if it be so situated, as upon the skull, that its base cannot be extirpated, potassa fusa or nitric acid should be applied to the part that is left, so as to produce exfoliation of it. The removal of these tumours is best effected by a Hey's or chain saw, or cutting pliers. In some situations, as when close upon joints, or springing from the cervical vertebrae, they cannot be interfered with; and in other cases, as occasionally happens in the neighbourhood of the orbit, their density and hardness may be such that the saw can scarcely work its way through them. There is one variety of exostosis which deserves special attention. It is that form of the disease which springs from the upper surface of the ungual phalanx of the great toe. It forms a small rounded mass, usually about half as large as a cherry, projecting under or beyond the nail, and giving rise to much pain and inconvenience in walking. Dupuytren, who first described this peculiar variety of the disease, has pointed out the treatment proper for it, which consists in exposing it by a double elliptical incision, and cutting it off with the scalpel, or a small pair of pliers, without amputating the toe.

There is a species of bony growth, called *Osteoma*, consisting of an uniform elongated mass of new bone, deposited on some of the osseous surfaces, somewhat resembling a node, and differing from ordinary exostosis in not being pedunculated. This does not admit of removal, and is not amenable to any treatment.

ENCHONDROMATOUS or OSTEO-CARTILAGINOUS TUMOURS are often met with. These have already been described when speaking of enchondroma and its pathology (p. 480), and need not, consequently, be more than adverted to here. They usually require resection or amputation of the affected bone, according to the attachments and size of the growth; but Stanley states that in some cases, where the cartilaginous tumour of bone is of small size, it may be influenced and eventually dispersed by the local application of iodine and mercury.

CYSTIC TUMOURS of bone of various kinds are commonly included under the terms *Osteo-sarcoma* and *Spina Ventosa*; which terms, having also been occasionally applied to various other solid growths, whether of a fatty, fibrous, gelatinous, or cartilaginous character, as well as to various kinds of malignant tumour springing from bones, have occasioned much confusion in the pathology of these affections.

Structure.—The cystic tumours of bone have been well described by Nélaton. They consist of cysts, having various kinds of fluid and solid contents. The cysts may be unilocular, and these are commonly filled with solid matter; or multilocular, and they then contain fluid. The solid masses are usually of a fibrous or fibro-cartilaginous character, filling up completely the cavity in which they are situated, and often attaining a very considerable size. They occur principally about the jaws and articular ends of long bones, especially the humerus, the femur, and the tibia. The cysts with fluid or semi-fluid contents attain a much larger size than the last, being often met with as large as a coconut or a fetal head. On a section being made of them, they are found to be composed of multilocular cysts, each cavity

having distinct walls, and often communicating with others. The fluid contained within these cysts is of various characters, thin and serous, sero-sanguinolent, viscid, or dark-coloured, often associated with masses of fibrous tumour, appearing as if it proceeded from the central softening of these large growths. The same situations are affected by the compound as by the single cysts, but they are also met with in the shafts of long bones. From whatever part they proceed, their walls are composed of expanded bone, not uniformly thinned, but thickened and nodulated at various parts, whilst it is perforated at others (Fig. 240).

These cystic tumours principally occur in adults, being rarely met with in children. They constitute smooth, round, or oval growths, increasing

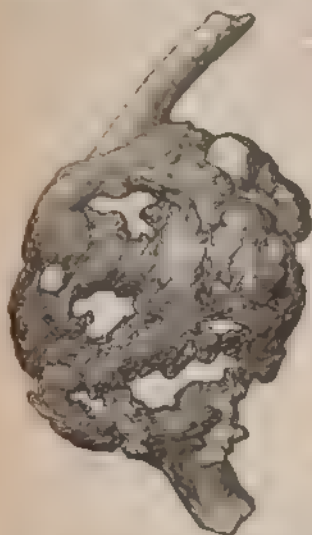


Fig. 240.—Cystic Tumour of Lower End of Long Bone.

slowly but steadily, with little or no pain; the skin covering them being of the normal colour, and the veins usually blue, enlarged, and tortuous. When a certain size has been attained, so that the shell of bone is expanded into a very thin lamella, and before it is perforated, pressure on the tumour occasions a peculiar cracking or rustling noise, like that produced by pressing together a broken egg-shell, or the cracking of tin-foil. Under this the elasticity or even semi-fluctuation of the tumour may be felt. This fluctuation is particularly marked after a time, when the osseous envelope has become still more expanded, or is partially or wholly absorbed.

Treatment.—When the contents of the tumour are solid, there is usually no means of ridding the patient of it but by the removal of the whole growth; by excision, if it be favourably situated for such procedure, as in the jaws; by amputation, if in the limbs. When the contents of the

tumour are fluid or semi-fluid, it must, if large, be treated in the same way as the solid growths are; but if it be small, or if of moderate size, so as not to have materially affected the integrity of the bone, it may suffice to remove one side of the wall of the cyst by the trephine or by excision, and then the cavity may be stuffed with lint, and allowed to granulate, and its walls to contract. This plan has proved especially successful in some of the cystic tumours of the lower jaw; and I have had occasion to practise it with success in a small cyst forming in the outer condyle of the humerus.

HYDATIDS.—Cavities are occasionally, but very rarely, found in bones, in which large numbers of hydatids are lodged; according to Stanley, both the acephalocyst and the cysticercus cellulose have been found in this tissue, but most frequently the first. In these cases a cyst forms in the bone, which becomes thin and expanded, resembling the ordinary fluid cystic tumour, but which, on examination, is found to contain the cutozoa. The treatment, as Stanley observes, must depend on the situation and extent of the disease; if it be a long bone that is affected, and it be much expanded, recourse must be had to amputation; if it be a flat bone, the cavity must be scooped out, and dressed from the bottom with stimulating applications, so that it may fill with healthy granulations.

CANCER.—*Malignant Osteoid, Osteo-cancer or Osteo-cephaloma*, are true malignant tumours of bone, constituting very serious but not very rare forms of cancer. Two distinct forms of cancer of bone are included in this disease. In one form the morbid growth is *central*, springing from the medullary canal, in the other it is *peripheral*, being attached to the compact osseous substance. Encephaloid of bone is harder and more fibrous-looking than the same affection elsewhere. The cancer-cell also is not so well marked, and minkow may be absent altogether.

In the *central* cancer of bone, the tumour is found to grow in the substance of, or to spring from, the interior of the medullary canal of the bone. It is usually situated at or about the articular ends, expanding the bone, which becomes completely enveloped and incorporated in the structure of the growth, either in the form of osseous rays diverging from the centre of the tumour, or more rarely as a thin shell of bone surrounding the mass, as in the more simple growths springing from this tissue. Under either circumstance it is important to bear in mind that this form of disease is never localised, but always invades the whole of the bone. The freedom of communication between the upper and lower ends of a long bone is so great, that, as has been shown by Richet, water injected at one end exudes in a few seconds at the other; hence the juices of a malignant structure might easily traverse the whole length of the bone, and we accordingly find, on examining the osseous tissue at a distance from the tumour, that there are red patches in it here and there indicative of its infiltration with the morbid structure.

In the *peripheral* form of cancer of bone, which is probably the most common variety, the osseous tissue is not so completely invaded; for, although the disease may be situated upon, or be in intimate contact with, the outer layers of the bone, which are incorporated in it, it does not extend into the cancellous tissue or the medullary canal. The tumour appears to spring from the periosteum; and, after removal and maceration, stalactitic projections and radiating fibres may be traced into it from the outer layers of the bone. In this form of osteo-cancer, the muscles that are attached to the affected portion of bone will often be found to be extensively infiltrated with cancer cells.

These tumours, whether central or peripheral, are chiefly of the encephaloid species of cancer, and are met with in all stages of development and of decay. Occasionally, some colloid, and more rarely melanotic matter is intermixed; but scirrhus, I believe, is never found in bone. They most frequently occur in the head of the tibia and the lower end of the thigh bone; occasionally in the humerus and in the jaws, more especially about the antrum. It is a remarkable fact, long ago pointed out by Petit, and more recently insisted on by Richet, and which I have often had occasion to verify, that although the epiphysis may have been completely converted into encephaloid matter, the cartilage of incrustation and of the neighbouring joint (Fig. 241) never becomes implicated; although the growth may eventually involve and include the whole of the rest of the articulation, by extension to the capsule and its soft parts. When internal organs become secondarily affected in these cases, the deposit will generally be found in the lungs.

Symptoms.—There is usually, with much lancinating pain, a rapidly growing enlargement of the bone, having a globular shape, feeling elastic, and sometimes semi-fluctuating. The skin covering it, at first pale, with numerous reticulated and blue tortuous veins, afterwards becomes discoloured, being eventually implicated in the morbid mass. In some cases fracture of

the bone takes place at the affected part (Fig. 242); the neighbouring tissues are speedily contaminated, the lymphatic glands become enlarged,



Fig. 242. Osteo-capsular of the Head of the Humerus, with Spinal Process Fracture of the Shaft in which I amputated successfully at the Shoulder joint.

Fig. 241.—Section of Osteo-capsular of Head of Humerus: Upper End and Head of Humerus destroyed, but cartilage of their station collected. Tumor divided by white vertical line—the Periosteum, inside which only were the Osseous Spicula found.

cancerous cachexy sets in, and the patient eventually sinks. In other cases, the disease being central, the progress, especially in the early stage of the disease, is less rapid, though it at last develops itself with fearful violence. So long as the disease is confined within the walls of the bone, it develops itself but slowly, and does not show much disposition to affect the constitution. Some years ago I had under my care a man whose thigh I amputated for cancer of the head of the tibia; the disease had existed for four years without contaminating the neighbouring parts. The patient's constitution appeared sound, and he made a good recovery. But when once the soft parts become engaged, the system is speedily contaminated. In some instances, pulsation of a thrilling kind, with or without a blowing murmur, is distinctly perceptible, especially in an advanced stage of the affection, when the vascularity of the tumour is greatly increased.

Diagnosis.—The diagnosis of osteo-cancer has to be made from other tumours of bone, and from aneurism. The malignant growths of bone may readily be confounded with those various forms of non-malignant disease that are commonly included under the term *spina ventosa*. In making the diagnosis, we may reasonably come to the conclusion that the growth is cancerous, if it occur in early life before puberty, or between this period and the early adult age; if it increase with great rapidity, and with much pain, especially of a lancinating character; if, to the touch, it present a somewhat diffused pulpiness, with much elasticity, great tension, and, at points, a semi-fluctuating feel; and more especially if the veins be greatly enlarged and tortuous, the neighbouring lymphatic glands involved, and if cachexy ultimately set in. These conditions, differing from the slow growth, the more circumscribed character, and more solid feel of the non-malignant

neighbouring structures, and which occur at later periods of life, usually enable us to make the diagnosis. There is one tumour, however, viz., *enchondroma*, which occasionally, in the rapidity of its growth, closely resembles malignant disease. Here the diagnosis is confessedly extremely difficult; though the more solid character, the less degree of elasticity, and the absence of lymphatic enlargement or implication of contiguous tissues, will often enable us to establish the true nature of a tumour before its removal.

The diagnosis of *aneurism* is necessarily unattended by any difficulty so long as its sac is pervious to fluid blood, and presents the characters that are met with in this condition. But if the sac have become consolidated by the deposit of stratified laminae, and thus have assumed the characters of a solid tumour, it may readily enough be mistaken for a tumour springing from the osseous structure, and amputation has occasionally been performed on this supposition. In these cases, however, the history of the progress of the disease will do more to elucidate its true nature than anything else, attention being more especially paid to the early symptoms of the tumour, when the aneurism was still filled with blood.

Treatment.—No means are of any avail in cases of osteo-cancer, except the removal of the diseased part by amputation or excision. These operations are, however, not very promising, as there are few forms of cancer in which the disease returns more rapidly in a secondary manner than in that of the bones. The rapidity of recurrence will, however, greatly depend upon the form of the disease, or the time when amputation is performed, and on the part where it is practised. Amputation should always, if possible, be performed in the earliest stage of the disease, before glandular or constitutional infection has set in. If the glands be enlarged, and cachexy have already occurred, little can be expected in the way of ultimate cure: yet I have known cases in which, even under these unfavourable circumstances, the patients have made a good recovery, life having been prolonged for months. I believe that return is much more speedy and certain after amputation in the peripheral than in the central form of osteo-cancer, provided that in the latter the whole of the bone has been removed; this is due to the more extensive contamination of the soft parts in the former than in the latter case.

The selection of the line at which amputation should be performed is of great importance, and the result will materially depend upon the judgment displayed in this. If the limb be removed in the continuity of the diseased bone, there must necessarily be a great probability of a very rapid return of the morbid action in the stump; and this probability amounts to a certainty in those cases in which the disease is central, and in which the whole of the medullary canal and cancellous structure are implicated, and infiltrated with cancer. In cases of peripheral osteo-cancer, this return in the same bone may not take place; indeed, I have seen one case of the kind in which the disease affected the lower end of the tibia, and that bone was amputated in its upper third; in this case, after a lapse of some months, fatal recurrence of the disease took place in the pelvic bones, but not in the stump. As, however, the peripheral is more rare than the central form of the disease, and as there are no means of ascertaining the precise kind before removal, the rule, I think, should be definite to amputate at or above the next joint—at the hip-joint, in cancer of the thigh-bone; in the thigh, for that of the bones of the leg, and at the shoulder, when the upper arm is affected. When the lower part of the thigh-bone, however, is involved, amputation through the trochanters may sometimes be substituted for disarticulation at the hip-joint, the latter operation being so formidable and so fatal that the surgeon

may think it advisable not to subject the patient to so serious a risk ; or the amputation might be performed through the trochanters, and then the head of the bone extirpated from the acetabulum. In this way the severity of the operation and the extent of incised surface would be lessened, whilst the whole of the diseased bone would be removed.

In the peripheral form of osteo-cancer, however, the muscles inserted into the affected bone often become speedily contaminated by the disease, and this contamination may spread widely through the substance of any particular muscle. Hence I think the rule in these cases should be to amputate not only above the diseased bone, but, if practicable, above the origins of the muscles in the neighbourhood of the disease. Thus, if there be a malignant tumour of the bones of the forearm, amputation should be done not only above the elbow-joint, but above the humeral attachments of the muscles of the forearm.

The propriety of *excision* of some bones, as of those of the face, in this disease, must depend on whether the morbid deposit is limited to the structures that can be excised. This operation can rarely be advantageously practised in malignant tumours, there being in general too great an implication of the soft structures in the neighbourhood to justify it.

SANGUINEOUS TUMOURS are occasionally met with in bones. According to Stanley, they appear under two forms :—1. As tumours composed of a vascular substance, having the general characters of erectile tissue, and bearing on section a close resemblance to certain naevi (Fig. 243) ; tumours of this



Fig. 243.—Aneurism by Anastomosis of one of the Parietal Bones.

kind may be removed without the liability to reproduction: 2. As cysts formed in the cancellous structure of a bone, and containing either fluid or coagulated blood. According to Stanley, these tumours expand the osseous walls, and will gradually cause ulceration of the skin and profuse hemorrhage.

The *Treatment* consists in the amputation of the limb, or the excision of the affected bone, as was successfully done by Travers, who removed a clavicle that was the seat of this disease.

OSTEO-ANEURISM.—Pulsating tumours of bone, or osteo-aneurisms, though of unfrequent occurrence, are of considerable importance to the practical surgeon, on account of the difficulty that often exists in establishing a diagnosis between them and ordinary aneurisms. It is only of late years that this kind of disease has been fully recognised ; and it is principally to the labours of Handyside, Nélaton, Stanley, and Roux that we owe an acquaintance with its characters.

Characters.—Tumours springing from bone, whether of a cartilaginous, fibrous, or cystic character, may have pulsation communicated to them from a neighbouring artery ; but the true pulsating tumours of bone owe their pulsations to some inherent peculiarity of structure, which appears to consist either in the development of a vascular tissue of abnormal character, or else

in the simple enlargement and dilatation of the vessels of the bone. In the first and most frequent class of cases, those in which a new tissue is developed in the osseous structure, we usually find the tumour to partake of an encephaloid character; a creamy, curdy or brain-like, soft, and very vascular mass is formed as an essential and principal constituent of it. This might consequently with propriety be termed an *encephalo-osteo-aneurism*. This abnormal mass will be found to present every shade of transition from true encephaloid cancer to a purely vascular tissue of an erectile character. In the second and more rare form of the disease, there is developed in the bone a structure, which originally, and in many cases throughout, is a *vascular erectile growth*, closely resembling capillary naevus in its structure, composed of an infinity of bloodvessels, interlacing in every possible way, so as to form a soft reddish-yellow tumour. In a third form, a hollow cavity is formed in the bone, scooped out of the cancellous structure and filled with blood, partly liquid and partly coagulated, and having arterial branches freely opening into it. The shell of bone surrounding this cavity is very thin and expanded, being usually absorbed at one point, where it often becomes at last perforated. This constitutes the *true aneurism of bone*.

Situation.—These various kinds of pulsatory tumour of bone have been met with in almost all parts of the body; most commonly the cancellous articular ends of the long bones, more particularly of the tibia, the radius, the humerus, and the femur, have been found affected. The pelvic bones are also not unfrequently the seats of these growths; and they have been encountered in the skull and in the ribs.

Symptoms.—In its early symptoms an osteo-aneurism closely resembles the ordinary forms of spina ventosa, being oval in shape, uniform, and elastic to the touch, growing slowly, without enlargement of the veins or discoloration of the skin; these characters it possesses in common with most other tumours of bone. The special signs by which it is individualised, however, are its pulsation and bruit: the pulsation is very distinct, superficial, and commonly of a thrilling character; in other cases it is directly impulsive, and distinctly expansive; the bruit is most usually soft and blowing, but not unfrequently harsh, loud, and whizzing. In some cases the bruit is absent, though the pulsation continue distinct, this, according to Nélaton, is most frequently the case in true osteo-aneurism. In the pulsating encephaloid form of the disease, I have heard the bruit peculiarly loud, rough, and superficial. On compressing the main artery leading to the part of the limb in which the tumour is situated, all movement and bruit commonly cease in it, and it lessens in size. By pressing upon the tumour when it is thus diminished, it will commonly be found to have a bony margin, with a central depression, more especially in those cases in which there is no encephaloid entering into its composition, the growth being apparently composed of erectile and expanded osseous tissue, filled with fluid blood. In some cases, however, the tumour is fed by several arterial branches, which may be felt distinctly pulsating under the skin. This is more particularly the case when it occurs upon the bones of the pelvis and the scapula, and then the bruit and pulsation cannot be made to cease in it. All these signs are commonly somewhat intermittent, appearing perhaps in the earlier stages of the disease, and disappearing as it advances; or the reverse may occur, the pulsation and bruit becoming distinct as the disease increases in size, and meets with more resistance in its outward growth.

Prognosis.—It is of considerable importance in many cases to diagnose the different forms of pulsating tumour of bone from one another; some being of a truly cancerous character, whilst others appear to consist of simple

expansion of the vascular element of the bone, with atrophy of its osseous substance; and consequently the prognosis also in the two conditions is very different. The true osteo-aneurism has so many signs in common with the *pulsating encephaloid tumour* of bone, that in many cases it is almost impossible to effect the diagnosis; yet it is well to bear in mind that the malignant form of the disease is not unfrequently multiple, occurring, with pulsation and bruit, in more situations than one: thus I have seen growths of this kind, with their signs well marked, springing both from the pelvis and from the ribs. The true osteo-aneurism is only met with in the articular ends of long bones; whereas the malignant disease, though commonly occurring in these situations, is also frequently found in other parts of the body. Besides these, there are two conditions which, in many cases, will enable the surgeon to determine that the pulsating tumour is an osseous aneurism: viz., the absence of all bruit, though the pulsation be distinct, and the detection by firm pressure, after the tumour has been diminished by compressing the artery leading to it, of an osseous margin around its depressed centre.

From *ordinary aneurism* the diagnosis of osteo-aneurism is, in many cases, attended by almost insuperable difficulties. So great are these, that there are many cases on record in which the most experienced surgeons of the day have ligatured arteries for tumours that were supposed to be aneurismal, but which have turned out to be pulsating growths connected with bone. A principal point to be attended to in effecting the diagnosis is the situation of the tumour, which may occur away from the ordinary sites of aneurism, in parts of the body where there is no vessel large enough to give rise to such a disease—as, for instance, about the head of the fibula or the side of the pelvis. Then, again, its incorporation with the subjacent bone, the want of a distinctly limited and circumscribed outline, and the existence in many cases of plates of bone in the wall of the tumour—giving rise perhaps, on pressure, to the peculiar rustling or crackling sound characteristic of expansive bony growths—will enable the surgeon to come to a conclusion as to the true nature of the tumour. In this he will be further assisted by its giving on compression a soft, doughy, or spongy feel, or appearing as a depression surrounded by an osseous margin. In many cases, also, the less impulsive character of the beat of the tumour, the peculiar shrill and tremulous whiz in the pulsation and bruit, will throw much light on the nature of the disease. But it cannot be doubted that, when tumours of this kind occur in some of the ordinary situations of aneurism, as about the brim of the pelvis, and in the popliteal space, the diagnosis is surrounded with difficulties which no amount of surgical skill or tact may be able to overcome.

From *ordinary tumours of bone*, the existence of pulsation and bruit will always suffice to distinguish the growths under consideration.

Treatment.—Incision into a pulsating tumour of bone, or any attempt to remove it without its osseous connections, is clearly contrary to the rules of good surgery; and when it has been practised, the hemorrhage has been of the most alarming and dangerous character. *Resection* has been had recourse to in some instances, as when the disease has been seated on the cranial bones, but without success. Liston, in a tumour of this kind growing from the scapula, which he called “an ossified aneurismal tumour of the sub-scapular artery,” excised the greater portion of the bone from which it sprang; but fungous growths reappeared in the wound, by which the patient was at last exhausted. When the disease has proceeded to such an extent as to produce extensive alteration in, and destruction of, the tissue of the bone affected, *amputation* of the limb is the only resource left to the surgeon. This operation is also called for in those cases in which the disease returns

After other means, such as the *ligature of the artery*, have been practised. In these cases, if the disease partake at all of the encephaloid character, the limb must be removed at a point above the affected bone.

The result of *ligature of the main artery* leading to the tumour depends greatly upon the nature of the growth. When it is partly composed of encephaloid or other solid tissue, but little good can result from this proceeding—the tumour continuing to increase by an inherent growth, which will continue as long as the vitality of the limb is maintained; and we accordingly find that, in all such cases in which this operation has been practised, the progress of the tumour has either not been retarded, or, if the pulsations have been stopped, and its size lessened for a time, the activity of the symptoms has speedily returned, and amputation has been rendered necessary. When, however, the tumour has partaken more of the characters of true *arterio-aneurism*, then a more favourable result has followed the *ligature of the main artery of the limb*. In a case of this kind seated in the radius, in which Roux ligatured the brachial artery, a complete cure resulted. The same also occurred to Lallemand; and in a patient of Dupuytren's, there was no return of the disease for six years, when it recurred, and amputation became necessary. These results are sufficiently satisfactory to justify the surgeon in having recourse to the *ligature*, or perhaps the *compression*, of the main artery of the limb, in those cases in which the tumour could be ascertained not to partake of the nature of encephaloid.

CHAPTER XLVIII.

DISEASES OF JOINTS.

THE various joints of the body may become the seat of *Inflammatory Affections* of an acute or chronic character; of *Strumous Disease*; or of various other morbid conditions, such as more or less permanent rigidity, or *Anchylösis*, the formation of *Foreign Bodies* within their cavities, or their *Malignant Degeneration*, and *Neuralgia*. In studying these various articular affections, it must be borne in mind that a joint is composed of a number of different tissues; of *synovial membrane*, *cartilage*, *ligament*, *bone*, and *capsule*, or investing fibrous expansion. In any one of these structures the disease may primarily begin, though eventually the morbid action often spreads to other tissues besides that which was originally involved. The merit of having been the first to point out the true mode of studying these affections in reference to the different structures in which they have originated, and to have set aside that coarse pathology which, under the general terms of "*arthritis*" and of "*white swelling*," confounded together these various diseases, is certainly due to Sir B. Brodie.

SYNOVITIS.

Inflammation of the Synovial Membrane, the most common perhaps of all the articular affections, may be acute, subacute, or chronic.

Cases.—Whatever form it assumes, *synovitis* usually results from exposure to cold, especially in rheumatic or syphilitic constitutions. In these cases it commonly happens that more joints than one are implicated at the same time; and the affected articulations are most frequently those that are most exposed by having the thinnest covering of soft parts, and by being

especially subjected to transitions of temperature, such as the knees and ankles. Injuries of joints, as blows, bruises, wounds, or sprains, will also frequently occasion this inflammation; but when arising from such causes, it is usually associated with inflammation of the other textures of the articulation.

PATHOLOGY.—As uncomplicated acute synovitis is never fatal, we seldom have an opportunity of studying its pathology. It would however appear, from the examination of joints in cases of synovitis from injury, as well as from the experiments of Richet, Bonnet, and others, who have induced traumatic synovitis in animals, that there is in the first instance an inflammatory congestion and vascularity of the membrane, with loss of its peculiar satiny polish. The synovia is then increased in quantity, and becomes thin and serous, and after a time intermixed with plastic matters which are poured out with it. If the disease progress favourably, these products are more or less completely absorbed. In more rare cases, the vascularity and swelling of the synovial membrane increase, until at last it becomes so turgid and distended with blood and effused fluids, that a kind of chemosis of it results; a thin, purulent-looking fluid, composed of granular corpuscles floating in a serous liquid, is poured out, and disintegration, with thinning and erosion of the cartilage, and probably complete destruction of the joint, ensues. In other cases, granulations are thrown out on the looser portions of the membrane, and, becoming injected with bloodvessels, constitute fringed and villous membranous expansions, lying upon the subjacent disintegrated and eroded cartilage.

SYMPTOMS.—*Acute Synovitis.*—The symptoms of synovitis consist of pain and heat of the joint, with distension and fluctuation of it. If it be large and exposed, the pain is severe, especially at night, being greatly increased by moving or pressing upon the articulation; it is usually sharp but, when the disease occurs in rheumatic or gouty constitutions, of a gnawing character. In purulent synovitis from pyæmia, it is usually very superficial, indeed almost cutaneous. On laying the hand on the joint, this will be felt to be hot.

The swelling of the affected joint is considerable, and evidently depends on accumulation of fluid within the synovial sac, the extreme outline of which is rendered apparent by the tension to which it is subjected. Thus in the knee it rises up high in the thigh under the tendon of the quadriceps extensor, to the extent of three or four inches above the upper border of the patella, and in the elbow under that of the triceps. There is but little if any effusion into the surrounding tissues; and hence the outline of the joint can be distinctly felt, and undulation perceived in it. The limb is usually semiflexed, as giving the patient most ease, and the joint cannot be moved. The constitutional febrile disturbance is tolerably severe, especially if the affection occur in a rheumatic constitution.

Chronic Synovitis.—The disease, at first acute, may terminate in a subacute or chronic form; or, subacute at its commencement, it may fall into a chronic condition. Chronic synovitis is characterised by all the symptoms of the acute variety of the disease, but in a less severe degree. The swelling and weakness of the joint are the most conspicuous local conditions. In some cases, the swelling from accumulated serous fluid is so considerable as to constitute a true dropsy of the joint—*Hydrarthrosis*. This accumulation of fluid, partaking in various degrees of the characters of serum and synovia, is usually preceded or accompanied by evidence of synovial inflammation; but, though this generally happens, it is not invariably the case. Richet, in particular, has recorded instances from which it would appear that inflammation is not a necessary or invariable accompaniment of the affection, the synovial membrane being indeed preternaturally white, and looking as

If it had been washed or soddened; and though these cases are rare, those that commonly present themselves to the surgeon being of a decidedly inflammatory character, yet their occasional occurrence is sufficient to establish the existence of a passive, as well as of an inflammatory form of the disease.

The presence of an abnormal quantity of fluid in the joint is always easily perceived by its *fluctuation* and *undulation*, and by the *peculiar steps* that it communicates to the part. Thus in the knee, which is the most common seat of this affection, the patella will be felt to float, as it were, on the subjacent liquid; and the capsule of the joint projects distinctly in three situations, viz., on each side of the ligamentum patellæ, and above that bone. In the elbow, there is a soft and fluctuating swelling on each side of the olecranon, and under the tendon of the triceps; and in the shoulder there is a general roundness and distension of the articulation. It is said that, in some cases, the distension of the joint has been so great that the synovial membrane has been ruptured, and the fluid poured forth into the surrounding cellular tissue. In these cases, however, it is probable that some destructive change in the synovial membrane preceded its rupture.

In some cases of chronic synovitis distinct *crackling* will be felt in the interior of the joint, on laying the hand over the articulation whilst it is freely moved. This appears to me to be due to the existence of plastic bands or deposits in the interior of the joint, through which the fluid is pressed by the articular movements, and thus occasions the sensation which is met with under other but similar circumstances in enlargements of the tumour, and in fluid effusions in the sheaths of tendons.

TERMINATIONS.—The termination of synovitis will depend mainly on its cause. When of a simple uncomplicated character, arising as the result, perhaps, of rheumatic influences, it will in most cases terminate in complete resolution. In other instances, however, plastic matter may be thrown out, which either assumes the form of warty vegetations or concretions within the joint, or of bands stretching across its interior or incorporated with its capsule, occasioning more or less permanent stiffness. When synovitis arises from wound, it usually goes on to suppuration within the joint, with superficial erosion or disintegration of the cartilage, and eventually, if the limb be not removed, to complete disorganisation of the interior of the articulation, and to more or less complete ankylosis. The same happens in the puerperal and pyæmic inflammations of joints; in which cases the morbid action commencing on the synovial membrane extends downwards to the cartilages, eventually destroying them.

The chronic or subacute synovitis and hydrarthrosis usually terminate favourably; but occasionally, more particularly in strumous constitutions, the disease runs on to suppurative destruction of the joint. This, however, is rare; yet its occurrence, in some instances, should make the surgeon careful not to confound the fluctuation of serous accumulation with that of purulent collection. In the latter instances the symptoms of inflammation will always have preceded.

TREATMENT.—The treatment of synovitis depends partly on the severity of the symptoms, and partly on the cause of the disease. If the inflammation be acute and arise from injury, it requires to be actively treated by venesection, if the patient be young and strong; but in all instances by the free and repeated application of leeches to the inflamed articulation, followed by fomentations and accompanied by perfect rest of the part on a splint, or on pillows properly arranged. In some instances, cold irrigation will be found to be of essential service. At the same time, saline purgatives with antimony must be given, and the patient kept on a low diet.

If the disease be of a *rheumatic* character, leeches must be applied, followed by hot fomentations, and rest of the part in the elevated position; at the same time colchicum, with salines, if there be much febrile disturbance, and in combination with Dover's powder, if there be much pain at night, should be administered. In some instances, where colchicum disagrees, great benefit will result from the administration of Dover's powder and calomel, in small but frequent doses. When the disease is of *syphilitic* origin, leeches are not often required; but the application of blisters, followed by calomel and opium, will be attended with marked success.

When the synovitis is *subacute* or *chronic*, the same principles of treatment must be adopted, modified according to the intensity of the affection. In these forms of the disease, rest is perhaps the most important element in the treatment, everything else proving nugatory unless this be attended to; the limb is usually best fixed by leather splints, buckled on so that they may be removed in order to make the necessary applications to it. In these cases, repeated blisterings over the whole of the joint constitute perhaps the most useful local means that we possess; in a more advanced stage, counter-irritation by means of stimulating embrocations, together with douches, either of warm sea-water or of some of the sulphureous springs, such as those of Harrowgate, Aix, or Barèges, will prove most useful; and when all inflammatory action has been subdued, and weakness of the joint merely is left, the joint should be properly strapped with soap-plaster, spread upon leather. Amongst the internal remedies likely to be of most service, may be mentioned the iodide of potassium, either alone, or in some bitter infusion.

In *hydrarthrosis*, rest and repeated blistering will usually promote the removal of the fluid. In addition to this, the employment of pressure and friction, with absorbent remedies, as the iodine or mercurial ointment, conjoined with the internal administration of the iodide of potassium or a mild mercurial course, will often procure the absorption of the fluid. If these means fail, we have a very powerful method of cure at our command in the injection of the joint with tincture of iodine. This plan, a sufficiently bold one, has been much employed by Jobert, Velpeau, and Bonnet. These surgeons use the tincture diluted with two or three parts of water. A small trochar is introduced into the joint, a moderate quantity of the serous fluid is let out, but not all, and then a corresponding quantity of the iodine solution is thrown in; and after being left for a few minutes, is allowed to escape. Inflammation of the joint, which is a necessary result of this procedure, comes on. This is then treated by ordinary antiphlogistic means, and, according to the statements of the French surgeons, has in no case been followed by any serious consequences, but in several instances by a complete cure without ankylosis; a new and healthy action having been imprinted on the synovial membrane. This mode of treatment does not appear as yet to have met with much support in this country; yet it certainly deserves a trial, though recourse should not lightly be had to it, as it is evident that the induced inflammation might exceed the expected limits. In one case of hydrarthrosis of the knee, in an old man, in which I employed it, about six ounces of thin synovia were drawn off, and a drachm of strong tincture of iodine was injected into the joint. But slight inflammation ensued; and the disease, which was of two years' standing, was completely cured. The chief points that appear to require attention are that no inflammation be going on at the time, there being no tenderness or pain in moving the joint, the effusion being quite passive, and of a very chronic character; and, above all, that no air be allowed to enter with the injected fluid. After dropsy of the joint has been removed, the articulation is usually

left weak for some length of time, in consequence of the stretching to which its ligaments have been subjected : here cold douches and an elastic bandage will constitute the best mode of treatment.

ARTHRITIS.

SIMPLE ACUTE AND CHRONIC ARTHRITIS.—By *Arthritis*, in its simple form, is meant inflammatory disease of an acute or chronic kind of the whole or greater part of the structures that enter into the formation of a joint. This affection may commence in the *synovial membranes*, and then spread to the other articular tissues ; or it may begin in the *cartilages* or *bones*.

Diseased action is very seldom primarily set up in the *ligaments* of the joint ; though these structures commonly become elongated, softened, and destroyed, as a consequence of other forms of articular disease. But, though primary inflammation of the ligaments is so rare an affection as to have been denied by many, yet it certainly does occasionally occur. This is especially seen in the hip-joint, where the inflammatory affection may commence in the round ligament ; illustrative of which there is a very beautiful model in the University College Museum.

Inflammation may commence in the *fibrous capsule* of the joint : this we find more particularly to be the case when the affection is of a rheumatic character ; in these cases inflammation, running into suppuration and slough of this structure, will commonly spread to the internal parts. In some instances, this form of disease gives rise to the deposition of masses and layers of bone in the cellular structures outside the articulation.

Causes.—In some instances, *acute necrosis* of the *shaft* of one of the long bones, as of the tibia, will run on to destructive action in the terminal articulations, the cartilages becoming undermined, softened, and perforated. It not unfrequently happens that the arthritic disease is the result of a *morbid condition* of the *articular ends* of the long bones, or of those short bones that enter into the formation of the joint ; this we especially see in diseases of the foot, of the elbow, of the knee, and hip ; but it is a condition which, I believe, may occur in any joint. The bones usually become, in the first instance, the seat of tuberculous infiltration ; this runs into unhealthy suppuration, which gives rise to caries and limited necrosis (Fig. 244 *a*) ; as the diseased action approaches the articular surface, the incrusting cartilage becomes loosened and detached, and at the same time gradually disintegrates, and becomes perforated (Fig. 244 *b*), nutrition in it being arrested or modified by the morbid state of the subjacent bone. When once the cartilage becomes affected, the whole of the interior of the joint speedily suppurates, and is destroyed. In other cases, inflammatory congestion, but without the formation of tuberculous matter, takes place in the articular ends, which become somewhat expanded ; and then, without any suppuration occurring in the osseous structure, the cartilage gradually separates or peels off, and becomes softened and necrosed. This condition is often met with in disease of the tarsal articulations.



Fig 244.—Chisel of Head of Tibia Perforation of Cartilage.

Arthritis commonly results from *wounds of joints, or injuries*, such as sprains and fractures occurring in their vicinity, more particularly in young people, and in those of a lymphatic constitution. It also occurs as a not unfrequent accompaniment of *pyæmia* (pp 463, 464), and of some of the morbid conditions of the *puerperal state*. The puerperal inflammation of joints is of a very destructive character, most generally speedily terminating in suppurative disorganisation. One or several joints may be affected, and the knee is the one that I have seen most frequently and seriously involved. Puerperal arthritis probably depends upon a purulent infection of the blood, the result of uterine phlebitis. Arthritis not unfrequently occurs as a consequence of *scarlatina*; and I have especially seen the knee-joint affected in a destructive manner after this disease. In some forms of *albuminuria* there is also a great tendency to inflammation of the joints; and, indeed, I have so frequently seen that form of renal dropsy which follows scarlet fever accompanied by serious inflammation of some joint, as almost to look upon one condition as the sequence of the other.

Symptoms.—The symptoms of arthritis that are most marked are the pain, heat, swelling, and peculiar position of the joint. The pain is often severe, tense, and throbbing: so acute is it sometimes, that the patient screams with agony; he cannot bear the bed to be touched, the room to be shaken, or the slightest movement communicated to the limb, any attempt at examination of the joint in such cases being attended with insupportable agony. There are usually nocturnal exacerbations, and the pain is commonly referred with especial severity to one particular spot in the joint; thus it is generally felt at the inner or under side of the knee-joint, and at the outer aspect of the hip. The heat of the diseased joint is considerable, and is often accompanied with more or less superficial redness. The swelling is uniform, involving the whole of the articulation, and not projecting at certain parts of it, as when the synovial membrane alone is affected; it is generally not very considerable, and has a soft and doughy, rather than a fluctuating feel. As the disease advances, however, the swelling generally increases suddenly, and to a considerable extent, either in consequence of the irritation of the synovial membrane, or of the accumulation of pus within or around the joint. In many cases the synovial membrane gives way, and the pus from the interior of the joint becomes widely diffused through the muscular interspaces of the limb, forming enormous abscesses and long sinuous tracts. The position of the affected limb is peculiar, and that attitude is insensibly adopted in which the patient will have the greatest amount of ease; thus the knee is semi-flexed and turned outwards, the thigh is adducted, and the elbow is bent. *Spasms or startings* of the limb, often of a very sharp and painful character, come on at times, more particularly at night. The constitutional disturbance is very severe, and of an actively febrile type.

As the disease progresses, *suppuration* takes place within the joint, which becomes hot and red, with a good deal of throbbing pain, and at last fluctuation is perceived where the coverings are thinned. In some cases the suppuration occurs with very great rapidity, and luxation of the head of the bone takes place. In other cases an abscess forms externally to the articulation, and extensive purulent collections become diffused through the limb. As the joint becomes loosened by the destruction of its ligaments, the bones become mobile, and grate against one another where the incrusting cartilage has been removed, thus giving rise to very severe suffering. The cartilages may, however, in some cases be very extensively destroyed, and yet no grating takes place; this is owing either to the destructive action being limited to the edge of the incrusting cartilage, the opposed surfaces being sound, or else

the interior of the articulation being filled up with plastic matter after the removal of the cartilages. But though abscesses, either within the joint or external to it, usually forms when the bones grate and the cartilage disintegrates, yet it occasionally happens that these conditions take place—these symptoms that are indicative of the erosion of the cartilage, such as painful startings of the limb, grating, and preternatural mobility of the joint—and yet no abscess forms; all the symptoms subsiding under proper treatment, and the joint recovering, though perhaps with a certain degree of ankylosis. If suppuration take place, the constitutional disturbance usually partakes of the irritative type, the patient suffering severe pain, and being worn out by want of rest. Hætic may occur, and death from exhaustion and irritation, unless the diseased part be removed; in other cases it falls into a state of chronic thickening, perhaps with fistulous openings leading down to the diseased structures; and in some of the more favourable instances the patient may recover, with a permanently rigid joint.

Diagnosis.—Abscess may form externally to, but close upon, the capsule of a joint, and closely simulate disease of the articulation. In these cases the absence of serious constitutional disturbance, the irregularity of the swelling, greater on one side than the other, its extension over bony points, as the patella or olecranon, the superficial character of the fluctuation, the absence of all rigidity about the joint, and of other severe local symptoms, such as pain, starting, looseness, or grating, will enable the surgeon to effect a correct diagnosis.

Pathology.—In arthritis, the principal changes are undoubtedly found to take place in the cartilages; at the same time, it must not be supposed that all morbid appearances that are found in these structures are the result of inflammation, as erosion and absorption of their tissue may take place independently of any diseased action. The long-continued disuse of a joint, as in the treatment of fractures, may occasion this; and in old people it is very common to meet with a porcellaneous or ivory-like deposit on the articular ends of the bones, which, however, does not prevent the joints from being used, though it may occasion stiffness and pain in them. According to Quakett, this porcellaneous deposit is of two kinds, one consisting of unorganised earthy matter, the other of true bone having the Haversian canals filled with phosphate of lime.

In acute arthritis, the cartilages are usually found ulcerated and eroded in patches of varying size, exposing bone, which is rough and vascular. The remains of the cartilage are softened, inelastic, opaque, and thickened, and separate easily from the subjacent bone, which can be felt rough and grating. The synovial membrane is usually much thickened and very vascular; the vascularity being most distinct about those parts where the erosions and grooves in the cartilage are deepest, and often assuming a dentated or fringed appearance. In other parts, especially

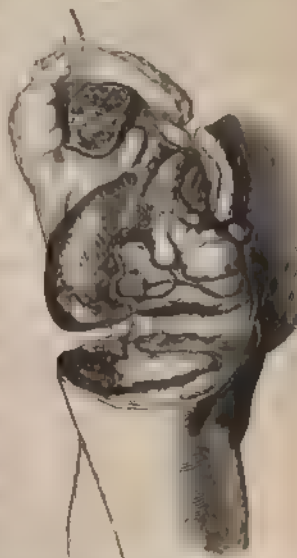


Fig 345.—Interior of Knee Unorganised by Inflammation.

about the circumference of the joint, masses of plastic matter are deposited underneath and upon the syno-

vial membrane ; these are smooth and semi-transparent, having a somewhat fatty look ; the ligaments are relaxed, vascular, and softened, and the interior of the joint is filled with thin, flaky, and light-coloured pus. The capsule and the cellular tissue around are thickened, and either infiltrated with pus or clogged with the same kind of plastic matter that is seen in the interior of the joint. The articular end of the bone is enlarged, soft, and vascular ; and in strumous cases may be the seat of tuberculous infiltration (Fig. 245).

Nature of the Changes in Cartilage.—The changes that take place in the cartilage in this disease have excited much attention amongst surgeons, and a good deal of difference of opinion exists as to the mode in which they are induced. Many surgeons hold the doctrine that, cartilage being extra-vascular, the changes that take place in it are accomplished through the medium of the contiguous synovial membrane or bone, and consequently are secondary to disease of these tissues. We may, I think, conclude that this disease of cartilage may arise in three ways: 1, through the medium of the Synovial Membrane; 2, through the medium of the subjacent Bone; and, 3, by means of changes taking place in the Cartilage itself.

1. The destruction of cartilage, as the result of *Synovial Disease*, may best be studied in cases of wound of a joint. In these cases it will be found, if the joint be examined before complete disorganisation of it has occurred, that the diseased action spreads from the synovial membrane, where it is most intense, downwards into the substance of the cartilage, which, superficially diseased, appears more healthy the deeper the examination of it is carried. Immediately under the swollen, gelatinous-looking, brightly injected synovial membrane, the cartilage will be found to be reddened, roughened, and softened. On examining a thin slice of this, it will be found to be composed of granular matter and nuclei of cells whose walls have disappeared. At a little greater depth than this it will present an opaque matrix, with cells, some perfect, others imperfect or disintegrating ; and below this level we come to healthy white cartilage, with clear matrix, and well formed cells.

The disorganisation of the cartilage will eventually go on to its complete removal, and to the exposure of bare and roughened bone. It is in this way that destruction of joints, as the result of punctured wounds, pyæmia, or puerperal inflammation, results.

Aston Key advocated the doctrine that a peculiar disease was set up in the synovial membrane, so as to form a fimbriated or fringed vascular network or tissue, by means of which the cartilage was absorbed ; and that, as this membrane extended, so did the removal of the cartilage go on. That an appearance of this kind in inflamed joints is of common occurrence is doubtless the case ; but Goodsir has shown that Key erred in attributing the disintegration of the cartilage to this membrane ; for he states that a fibrous tissue forms in a diseased joint as the result of the disintegration of the cartilage, and that this, which is connected with either the synovial or the osseous surfaces, speedily becomes vascular. So far, therefore, from being the organ by which the cartilage is removed, it is the result of prior disease in this structure. At the same time it cannot, I think, be doubted that a villous injected state of the synovial membrane will modify the nutrition of the subjacent cartilage in such a way that disintegration, erosion, and apparent ulceration of it, will ensue.

2. Disease of cartilage primarily dependent on *Morbid Action in the Subjacent Bone* is, I believe, one of the most frequent modes of disorganisation of joints in strumous subjects, and most certainly leads to those

rapidly destructive affections of joints, in which amputation or excision is required. In these cases, either as the result of violence, or from constitutional causes, the articular ends of a bone, or the whole of a bone if it be one of the tarsal, becomes congested, inflamed, carious, or necrosed, sometimes infiltrated with tubercle. In consequence of this disorganisation of the osseous tissues, the incrusting cartilage becomes detached, its under or attached surface softened, and at last perforation takes place, as in a preceding cut (Fig. 244 b, p. 739), taken from the tibia of a boy whose limb I amputated for acute disorganisation of the knee-joint, following carious disease of the head of the tibia. This process of disintegration, and at last perforation and erosion of the cartilage, takes place in a direction from below upwards. So soon as perforation occurs, the whole of the interior of the joint becomes acutely inflamed, and suppuration is set up in it, the ligaments loosen, and complete disorganisation ensues (Fig. 244). On examining the diseased patch of cartilage in cases of this kind, it will be found to correspond to the carious or tuberculous bone, from which it is separated by some bloody fluid; it will also be seen that the under edges of the erosion or perforation in the cartilage are separated to some extent from the subjacent bone, from which they readily peel off, and that they are bevelled off towards the aperture.

3. That cartilage is susceptible of *Primary Change of the Nature of Inflammation or Ulceration*, induced by the action of its own vessels, is the opinion of Brodie, Mayo, and Liston, all of whom have observed true vascularisation of cartilage. This condition, however, is extremely rare, and is certainly not one of the more common forms of joint-disease, seldom occurring except in the more chronic stages of arthritis.

These, however, are not the sole changes that take place in the cartilage in arthritis; the observations of Goodsir, of Rainey, and of Redfern, all point to the fact that cartilage, like other extravascular tissues, is subject to other transformations, independent of the prolongation of vessels into it. The changes that ensue are, according to Redfern, of the following kind. The cartilage-cells enlarge, become rounded, and granular-looking; and, instead of their containing two or three nuclei, a considerable number are enclosed in the cell-wall, eventually these corpuscles break up, and are disintegrated. The matrix of the cartilage now softens, and, according to Redfern, splits up into fibres or bands which become nucleated. A species of fatty degeneration also, as pointed out by Rainey, takes place, and helps to soften and break down the structure of the cartilage. In the more advanced stages of disease of cartilage, masses of porcellaneous deposit are found attached to the ends of the bones in plates and layers, taking the place of the eroded cartilage.

In other cases, a soft, pulpy, and vascular fibro-plastic deposit of a greyish, sahy, or reddish brown colour, with whitish streaks of a firmer material running through it in various directions, takes the place of the cartilage that has been removed, or that has undergone fibro-cellular degeneration. On examination under the microscope, this will be found to be composed of plastic material, with cartilage-corpuscles intermixed, and with the subjacent bone in a state of disintegration and softening. This condition of joints I believe to be analogous to the "pulpy degeneration of the synovial membrane" of Brodie. It would appear, from the microscopical examinations that I have in various cases made of this material, to which my attention was first directed by Dr. Quain, as occurring in a patient of his whose elbow-joint I excised, that it is either fibro-cellular degeneration of the cartilage, or an imperfect attempt at repair set up in the articulation, after the

removal of the cartilage by previous disintegration and disease. On making a vertical section of the surface of the diseased articulation in the case alluded to, it was found that the pulpy and villous substance covered the bone to the thickness of a line and more in some parts. The bone was found to have its cells filled with oil-globules, but surrounded by tolerably healthy osseous tissue, showing the usual laminae and bone-corpuscles. Nearer the diseased surface the laminae and corpuscles became less distinct; and, still nearer, the cells of the bony tissue appeared to be surrounded merely by a layer of fibrous texture, in which irregular particles of bone were observed. These particles, which were elongated, irregular in form, and rounded off at the angles, were very aptly compared, by Dr. Quain, to crystals in a state of solution. At the diseased surface, the place of the cartilage and synovial membrane was occupied by a fibrous texture abounding in cells, larger than pus-cells, nucleated and spherical, containing numerous granular particles. Irregular masses of cartilage, undergoing the same process of softening as the bony particles already mentioned, appeared in this fibrous texture. The morbid appearances found in this case were so characteristic that they may be taken as the type of this peculiar morbid condition, which I have since repeatedly met with in other articulations besides the elbow, more particularly those of the fingers and the knee, and which always, I believe, constitutes an incurable form of disease. I have met with this condition in instances only in which the articular affection has been of very old standing, and has fallen into a truly chronic state.

Repair.—When repair takes place in a joint, the cartilages of which have been eroded or destroyed, it is by the articular ends of the bones becoming connected, and the surface from which the cartilage has been removed filled up by fibro-cellular tissue, forming a kind of cicatricial material that leaves the joint permanently stiffened. In other cases, porcellaneous deposit takes the place of the eroded cartilage; and, in some instances, the exposed osseous surfaces may grow or become soldered together, forming a permanently ankylosed and immovable state of the articulation. Under no circumstances does cartilage, when once destroyed, become regenerated.

Treatment.—In the treatment of *acute* arthritis, perfect rest of the articulation is of the first moment. Unless this be secured, no after-treatment can be of any avail. The limb should be comfortably supported on pillows, or laid upon a well-made and softly padded leather-splint; at the same time blood should be freely taken away by cupping or leeching the affected part, and this local depletion must be followed by assiduous fomentations. In the acute stage of the disease, the internal remedy from which the most essential service may be derived is the calomel and opium pill (gr. $\frac{1}{2}$ and gr. $\frac{1}{4}$) every fourth or sixth hour, at the same time that a strict antiphlogistic regimen is persevered in. After the violence of the symptoms has been subdued, and the disease has assumed a *chronic subacute* form, the joint may be repeatedly blistered; but in many instances most benefit will be derived by the application of the actual cautery. This agent, when properly applied, yields much more certain and successful results than any other form of counter-irritation with which I am acquainted. The patient having been anaesthetised, a cauterising iron heated to a black-red heat should be rapidly drawn over the diseased articulation in a series of parallel lines, across which an equal number of cross-bars are again drawn, so as to char, but not destroy, the true skin. A good deal of inflammatory action is thus set up, followed by slight suppuration. When this has subsided,

the application of the hot iron may, if necessary, be repeated; in this way the deep gnawing pain will usually be readily removed, and suppuration of the joint may be averted. For counter-irritants to be of any use, they must be employed before suppuration has set in; I believe that it is only torturing the patient unnecessarily to have recourse to these agents when once pus has formed in the articulation. In order that full benefit should be derived from this plan of treatment, it must be persevered in steadily for a considerable length of time, and should be conjoined with a moderately antiphlogistic and alterative treatment. With this view, the bichloride of mercury, in doses of from one-eighth to one-twelfth of a grain, may be advantageously given with the compound decoction of sarsaparilla, or, if there be much debility, with the compound tincture of bark; nourishment, and even stimulants, being conjoined with it, in proportion to the advance of the debility. When suppuration has taken place in the joint, more particularly if the skin covering it be reddened at any one part, the abscess should be freely opened by one or two lateral incisions, extending fairly into the joint, so as to afford a free exit for the pus.

In some cases, even when abscess has formed, the joint being perfectly loose and grating, by perseverance in proper treatment, both local and constitutional, a good and useful limb may be left; and although there be mobility and grating, provided there be no sign of abscess, the surgeon should never despair of obtaining a satisfactory result.

The practice of making free incisions into a suppurating joint, as advocated by Mr. Gay, is a great improvement on the former method of merely puncturing it. If a small aperture only be made, air is admixed with the pus, which becomes offensive and irritating, and, being unable to escape freely, sinks to the bottom of the articulation with *débris* of the disintegrated cartilages, &c., giving rise not only to much local mischief, but to proportionate constitutional disturbance. By freely laying the joint open, all this is prevented; exit is given to the pus through one or two incisions that extend the whole length of the articulation; no constitutional disturbance can occur from pent-up and putrid matter, and the joint has a better chance of healthily granulating.

After the formation of abscess the prognosis is more unfavourable, when large joints such as the knee or hip are affected; or when those are implicated which are important to life, such as the articulations of the vertebrae; so, likewise, when the articular ends of the long bones are affected, it is seldom that the joint can recover itself, as caries or necrosis are complicating its disease and keeping it up. When the articulation is very sinuous, as in the carpus, or when a number of small joints communicate with one another, if not directly by synovial membrane, at all events indirectly through the medium of ligament and of fibrous tissue, as in the tarsus, a cure can scarcely be anticipated. In all these cases, hectic and great constitutional irritation usually come on; or, the joint becoming useless or cumbersome, its removal must be practised either by excision or amputation.

The result will at last in a great measure depend upon the state of the bones that enter into the conformation of the joint. If these be sound, or not primarily affected, and the patient's constitution have got over the effect of the occurrence of suppuration in the joint, ankylosis more or less complete may be confidently looked for. But if the articular ends of the bones be primarily or deeply implicated, then excision or amputation will be the only alleviation.

When an inflamed joint appears to be disposed to unrepair by ankylosis must be facilitated by keeping it in

This disease most frequently occurs amongst the poorer classes, and is almost invariably met with in males. It usually occurs about the age of fifty, though sometimes earlier. I have seen two instances of it in individuals little more than thirty years of age, one of whom was a female. It is an incurable affection, and, as it is commonly attended by much suffering, constitutes a source of great discomfort to the patient.

Diagnosis.—It occasionally happens that individuals labouring under this affection, meeting with a fall or contusion on the hip, present signs of fracture of the neck of the thigh-bone, such as shortening, eversion, with some crepitation perhaps, and inability to move the limb. The diagnosis may in general readily be effected by attention to the history of the case, and by eliciting the fact, that the symptoms have existed to some degree before the accident, although the pain and immobility may have been increased by it.

In the *Treatment* of this affection, little can be done. Rest and the habitual application of warm or stimulating plasters will afford relief, and, in many instances, the administration of the iodide of potassium with sarsaparilla will lessen the nocturnal pain. Dr. Smith recommends an electuary composed of guaiacum, sulphur, the bitartrate and carbonate of potash, and ginger, with a small quantity of rhubarb; and I have certainly seen benefit result from the administration of this remedy in some cases. When the disease is once fairly established, and has assumed a very chronic character, nothing can be done except to mitigate the pain by some such means as those recommended, conjoined with rest and careful attention to the general health.

Dry Chronic Rheumatic Arthritis of the Lower Jaw.—Chronic rheumatic arthritis has also been described by Dr. Smith as occasionally affecting the temporo-maxillary articulation in individuals of rather advanced life. This disease is mostly symmetrical, and gives rise to an enlargement of the condyle of the jaw, which can be felt under the zygoma, attended with much pain in opening the mouth, a sensation of cracking or grating in the joint, and some enlargement of the lymphatic glands by the side of the neck. The pain is generally increased at night, and influenced by the state of the weather. The face becomes distorted, the affected side of the jaw projecting and being pushed towards the opposite side; but when both joints are affected the chin projects, the entire jaw being drawn forwards. This distortion is chiefly owing to the destruction of the articular eminence; for when this takes place, the external pterygoid muscle draws the jaw forwards and to the opposite side; but when both articulations are equally affected, those muscles displace it directly forwards: the glenoid cavity becomes enlarged, the fibro-cartilage disappears, and the condyle is sometimes greatly thickened and flattened, and always rough, being devoid of cartilage. In such cases there is but little to be done by medicines; but the treatment must be conducted on the same principles as in the same affection attacking the hip.

Dry Chronic Rheumatic Arthritis of the Shoulder.—When it affects the shoulder, chronic rheumatic arthritis gives rise to a considerable enlargement of the head of the humerus, wasting and rigidity of the deltoid, and inability to move the elbow upwards, except by the rotation of the scapula on the trunk. In fact, the scapulo-humeral articulation being fixed, all movements of the shoulder are effected through the medium of the scapula, which becomes more mobile than natural. The articulation is the seat of much pain, lancinating at times, but generally gnawing and intermittent, being dependent on the state of the weather, and greatly increased in cold

and wet seasons. The whole of the arm becomes wasted, and weakened in power. In two instances I have seen this disease in young and otherwise robust and healthy men, between twenty and thirty years of age, coming on without any apparent cause. In both cases the joint continued permanently rigid, though the pain was relieved by the use of the iodides and by local counter-irritation.

CHRONIC STRUMOUS ARTHRITIS: WHITE SWELLING.—By *White Swelling* is meant a very chronic form of arthritis occurring in scrofulous subjects.

This condition has not in many cases any definitive starting-point, but appears slowly to supervene upon some slight injury, as a twist, or blow, or strain; at other times it commences with a subacute synovitis, assuming its peculiar characters by occurring in a strumous constitution, and is especially liable to happen in children and females.

Symptoms.—The disease presents peculiar characters. The affected joint is enlarged and rounded, the bony prominences being effaced by an uniform, doughy, semi elastic, or pulpy swelling, occupying the interstices of the articulation. The integuments covering it preserve their white colour; there is usually but little pain felt except in moving the limb; and the position is always that in which the patient has most ease, the joint being generally semiflexed. There is a degree of stiffness and rigidity in the joint; and, in consequence of the wasting of the limb from disuse, the affected articulation appears more swollen than it really is. The general health does not appear at first to suffer much; but, as the disease advances, symptoms of irritation and hectic declare themselves. This affection is always characterised by a special tendency to run on to suppuration, and in the majority of cases at last passes into this condition, although the tendency may be checked by proper treatment. The joint suffers from exacerbations of intercurrent attacks of inflammation, the limb swells and becomes cedematous, and abscess finally forms in and around the joint; often around, before it takes place within. When this is opened the constitutional symptoms become more severe, hectic speedily sets in, and strumous deposit takes place in other organs, such as the lungs, which at last carries off the patient.

Pathological Changes.—In this affection the tissues immediately external to the joint, as the fibrous capsule and the investing cellular membrane, are always much thickened and infiltrated with fatty and plastic matter; and the great tendency of this gelatinous infiltration to run into unhealthy suppuration greatly adds to the mischief that ensues. In the interior of the joint, we find much the same kind of changes that have been described as characterising acute arthritis; the cartilages have lost their polish, their elasticity, and their firm hard section, being softened, eroded, and disintegrated; the synovial membrane is removed in parts, and is here and there vascularised; in others it is replaced, together with the cartilages, either by large quantities of the semi-transparent gelatinous-looking fatty deposit, or by the pulpy grey or brownish fibro-cellular material, that are met with in arthritis. The ligaments are inflamed, softened, and destroyed, being converted into somewhat amular materials; and the interior of the joint is filled with a purulent-looking synovial fluid, thin and yellow, usually containing a large quantity of fatty matter. The bones undergo important changes in this disease, the articular ends becoming expanded and enlarged; and, though this was denied by Crowther, Russell, and others, it is affirmed by more modern surgeons, and I have had repeated opportunities of determining the fact. In all the cases that I have examined, the osseous tissue has undergone important changes, the compact structure having become thin and expanded, and the cells

of the cancellated portion filled with a bloody and fatty serous fluid. The bone is softened, often cutting readily with the knife; and, owing to the deposit of fat, presents a more homogeneous section than healthy bone. In many cases, tuberculous matter is deposited in it. From this it would appear that the principal changes that take place in a joint affected with white swelling consist in a kind of fatty degeneration of the tissues that enter into the formation of the articulation, associated with an unhealthy strumous inflammation of the parts, and in the consequent deposition of considerable quantities of semi-transparent and lowly organised plastic matter which, in its turn, has a tendency to undergo the same structural change, or to run into unhealthy suppuration.

Treatment.—In the treatment of white swelling, we must bear in mind that we have to manage a truly scrofulous inflammation and its effects. Our first object should be to prevent, if possible, the occurrence of suppuration. In the early stage, when the affection has come on insidiously, without any very active symptoms, we must trust to general antisthmous treatment, to the influence of good diet and sea-air, and to the administration of tonics, cod-liver oil, and iodine.

In the local treatment there are three great principles to be carried out. 1. *Rest, with perfect immobility* of the joint, is by far the most important element in the treatment, without which all the efforts of the surgeon to prevent suppuration and disorganisation of the joint will be futile. 2. *Compression*, by means of bandages, strapping, or splints, will aid in the absorption of the plastic effusion in and around the joint. 3. *Counter-irritation* by means of issues, blisters, or the actual cautery, must be employed. These means, to be of real service, should be used before suppuration has occurred; after this, I believe they are of no use. The limb should be put into a position which is not only most easy to the patient, but will leave it most useful should a stiff joint result. If it be one of the joints of the lower extremity that is affected, especial care must be taken that the patient do not bear his weight on it. If the symptoms be of rather an acutely inflammatory kind, a few leeches may be applied: these, however, must be used as sparingly as possible, being confined either to the earlier stages of the disease, or to the subdual of any more active intercurrent inflammation. Rest is best secured by well padded leather or gutta percha splints in the earlier stages; and, at a later period, by the application of the starched bandage, well lined with cotton wadding, to the limb. This kind of application will be found to give the most efficient support, and will keep the whole of the limb perfectly motionless, so that the patient can take open air exercise, and walk with the aid of crutches, without the risk of injuring the diseased joint. In this respect the starched bandage presents great advantages over the short leather splints generally used. It may readily be cut open opposite the diseased joint, so as to admit of the application of proper dressings to it. The actual cautery is extremely beneficial in these cases, applied as directed (p. 744); or caustic issues may be put in, at a little distance from the articulation, so that there may be no risk of the inflammatory action penetrating to it.

After all inflammation has, in this way, been removed, and nothing but thickening and stiffness of the joint are left, measures must be adopted for removing these conditions, and restoring the flexibility of the articulation by friction with somewhat stimulating and counter-irritant embrocations, and eventually its strength by douches of sea-water. The swelling and pulsations that are left, together with the debility dependent on relaxation of the ligaments, are perhaps best remedied by the use of Scott's strapping, but

pressure should not be applied so long as there is evidence of active inflammation going on in the articulation, which it would certainly increase.

If abscess form, it must be freely opened by an incision of a proper length, the joint poulticed, and the patient's general health attended to, so as to promote the evolution of granulations, and prevent hectic. In these cases, if the limb can be preserved, its subsequent utility, and the patient's comfort, will mainly depend upon the position in which it is allowed to become ankylosed.

ANCHYLOSIS, OR STIFF JOINT.

Anchylisis is invariably the result of the destruction of a joint by inflammation, being one of the modes by which nature effects its repair. It consists in the more or less complete consolidation of the parts around and within the articulation. It is of two kinds: the *Incomplete*, or *Fibro-cellular*; and the *Complete*, or *Oseous*.

In the *Incomplete*, or *Fibro-cellular Anchylisis*, the stiffness of the joint may be dependent on thickening and induration of its fibrous capsule, or on the formation of fibroid bands as the result of inflammation within the joint, or in consequence of the cartilages and synovial membrane being in part or wholly removed, and their place supplied by a fibroid or fibro-cellular tissue, by which the articular ends are tied together. The stiffness may be materially increased by the shortened and contracted state of the muscles around the joint. The incomplete, or fibrous anchylisis, is the most favorable termination that can usually be expected in chronic scrofulous affections of joints. In some cases it arises simply from disuse: the limb becoming stiffened in the position in which it has been too long detained.

Complete or Oseous Anchylisis is of two kinds. In one, all the soft parts within the joint are destroyed, and the osseous surfaces have conformed, or are fused together by direct bony union; this is most commonly seen in the hip, knee, and elbow (Fig. 248).

In the other kind there has been fibro-cellular deposit, or degeneration within the joint; and the bones, united partly by this, are also tied together by arches or bridges of osseous matter, thrown out externally to the articulation, and stretching across from one side to the other. It has been supposed that these masses proceed from the ossification of the ligaments, or even the muscles; but, from the inequality of their appearance, it is evident that they are new and accidental formations.

The true or osseous anchylisis does not occur as a consequence of scrofulous articular inflammation, but is usually the result of traumatic inflammation in persons of a healthy constitution. In the incomplete anchylisis there is always some degree of mobility, however slight, and, indeed, perhaps only perceptible on deep and close examination. In the complete form of stiff joint, the articulation is perfectly rigid and immovable. It not unfrequently happens, in old standing cases of diseased joint, that more or less complete anchylisis is taking place at one part of the articulation, whilst caries or necrosis of the bones is going



Fig. 248.—Complete Anchylisis of Hip.

on at others. Under such circumstances, excision or amputation will, probably, be the course to be pursued.

TREATMENT.—The *treatment* of ankylosis is, in the first instance, of a precautionary nature; that is to say, when the surgeon finds that the establishment of ankylosis is, as it were, the natural means of cure adopted by nature in a deeply diseased joint, his efforts should be directed to seeing that the joint becomes ankylosed in such a position as will leave the most useful limb to the patient. Thus, if it be the hip or knee, the ankylosed joint should be in the straight position; if it be the elbow, it should be placed at a right angle.

When once ankylosis has occurred, the treatment to be adopted will depend partly on the degree of stiffness, whether it be fibrous or osseous; and partly on the object to be attained, whether this be merely the restoration of mobility in a part ankylosed in a good position, or the remedying of the deformity occasioned by faulty ankylosis.

1. In attempting to restore the mobility of a joint ankylosed in a good position, as of a straight but stiff knee, the surgeon may usually succeed if the ankylosis be only fibrous, (when some degree of movement will always be perceptible in the part,) by the employment of passive motion, frictions, and douches, more particularly with warm salt water or the mineral sulphureous springs. In the more obstinate cases, and where the immobility appears to depend, in some degree at least, on fibrous bands stretching across the limb, an attempt might be made to divide these subcutaneously. In doing this no mischief can result; for, the synovial structure of the joint having been destroyed, no dangerous amount of inflammation can be set up in it.

2. When fibrous ankylosis has taken place in a faulty position—if, for instance, the knee be bent, or the elbow straight—the first thing to be done is to place the limb in such a position that it will be useful. This may most readily be done by putting the patient under the influence of chloroform, and then forcibly flexing or extending the limb as the case may require, when with loud snaps and cracks it will usually come into proper position. Should any of the tendons near the joint appear to be particularly tense, they may be divided subcutaneously. Either some days before the extension is attempted, or else if it have been carried as far as the rigid state of the tendons will permit, tenotomy may be practised, and, an interval of a few days having been allowed to elapse, extension may be completed. The inflammatory action that follows this forcible extension or flexion of the limb is usually but very trivial; an evaporating lotion and rest will speedily subdue it. Indeed, it is surprising what an amount of violence may be inflicted on an ankylosed joint without any bad consequences ensuing. After the limb has been restored to its proper position, passive motion and frictions may tend to increase its mobility.

3. When osseous ankylosis has taken place, and the position of the limb is a good one, it will generally be wiser for the surgeon not to interfere; except in the case of the elbow-joint, which, under these circumstances, may be excised with advantage, so as to substitute a movable for an immovable articulation. If the position be faulty, the osseous union may be divided, or a wedge-shaped piece of the bones may be taken out, and the position of the limb thus rectified.

4. Amputation may be required in cases of faulty ankylosis with so much atrophy of the limb as to render it useless, or in cases in which there is necrosed or carious bone co-existing with ankylosis and rigid atrophy of the muscles of the limb.

LOOSE CARTILAGES IN JOINTS.

It sometimes happens that in the instance of a joint the synovial membrane assumes a warty condition, as the result of chronic irritation of the articulation. This warty state of the membrane usually consists of flattened fibroid deposits upon its surface. In other cases these may become pedunculated, and pendant into its interior. For this condition, which gives rise to occasional uneasiness and puffiness about the joint, with a crackling or creaking sensation when it is moved, but little can be done beyond the application of discutient plasters and the use of elastic bandages.

Loose Cartilages, as they are termed, are not unfrequently met with in the different articulations. In many cases they are not truly cartilaginous, but appear to be composed of masses of condensed and indurated fibroid tissue, not very dissimilar in structure from the warty synovial membrane just referred to, and from which they appear to be detached. In fact, the flattened and tuberculated fibroid deposits forming warty growths, the pedunculated fibroid masses, and the same detached or lying loose in the interior of the joint, appear to be successive stages or conditions of the same pathological formation. Though commonly fibroid, it is probable that in some cases these bodies may be truly cartilaginous.

CHARACTERS.—These bodies vary in size from a barley-corn to a chestnut. When small, they are round; when large, they are somewhat flattened or depressed on the surface. They are smooth, shining, and usually of a yellowish or greyish white colour. They are most frequently met with in the knee; but not uncommonly occur in the elbow or the joint of the lower jaw, and occasionally in the shoulder. Most commonly only one is found; but their number may range from this up to fifty or sixty.

SYMPTOMS.—The severity of the symptoms will to a great extent depend upon the mobility of the loose cartilage, and its consequent greater or less liability to be nipped between the opposite articular surfaces in the movements of the joint. When these bodies are tolerably firmly attached to the synovial membrane, they may merely occasion weakness of the joint, with occasional synovial effusion. When loose, they usually give rise to a very distinct train of symptoms. The most marked of these is the very severe pain which occurs in particular movements of the limb. This comes on suddenly, prevents the patient from either straightening or flexing the joint completely, and is often so intense as to cause faintness or sickness. It is usually followed by a degree of synovial inflammation, and by relaxation of the ligaments. These attacks of pain and of sudden irritability of the part come on at varying intervals, as the result of movements of it: they commonly happen in the knee whilst the patient is walking. It is difficult to say to what this severe pain is due. Richet thinks it may be owing to the synovial membrane being pinched between the foreign body and one of the articular surfaces. I think that it is most probably due to the foreign body being drawn in between the opposite surfaces of the joint, when these are separated anteriorly in the act of flexion of the knee, and then, when the limb is extended, acting as a wedge between these, tending to keep them separate and interfering with the complete straightening of the limb. In consequence of this wedge-like action of the loose cartilage the ligaments are violently stretched, and the sickening pain consequent on this act is experienced, followed, as happens in a violent sprain, by rapid synovial effusion. The sensibility of the ligaments of a joint is of that peculiar nature that it is only called into action when an attempt is made to stretch them, and thus forcibly to counteract or destroy their natural use. Ligaments may be cut without any suffering, but they

cannot be stretched, either by accident or disease, without the most severe pain. In some cases the loose cartilage can be felt by carrying the finger over the joint, when it may be detected under the capsule, slipping back when pressure is exercised upon it, and often possessing great mobility, gliding from one side of the joint to the other, so as to be extremely difficult to be fixed.

TREATMENT.—The treatment consists in supporting the joint with an elastic bandage or knee-cap, so as to limit its movements, and thus prevent the liability to the recurrence of the attacks of pain; and in this way the fixing or absorption of the cartilage may sometimes be obtained. Any inflammatory action that has been excited requires to be subdued by proper antiphlogistic treatment.

If the cartilage occasion great and frequent suffering, so as to interfere seriously with the utility of the limb, and if it appear to be of large size, and to be loose and single, means may be taken for its extraction. But it must be borne in mind that, whilst the loose cartilage is at most an inconvenience, though perhaps a serious one, any operation for its removal by which the joint is opened, becomes a source of actual danger to limb and even to life. It is far less dangerous, in fact, to leave the foreign body than to perform the operation necessary for its extraction. Hence an operation should not be lightly proposed or undertaken, without warning the patient of the possible consequences that might follow. No operation should be undertaken so long as the joint is in an irritated state, as the result of a recent attack of pain; this must be first subdued, and then the operation may be proceeded with. The extraction used to be effected by directing the patient in the first instance to make those movements by which he usually gets the cartilage fixed in the joint. So soon as the surgeon feels it (as this operation is commonly required in the knee), he should push it to one side of the patella, where he must fix it firmly with his forefinger and thumb, he then draws the skin covering it to one side, so as to make it tense, and cuts directly down upon the cartilage by a sufficiently free incision to allow of its escape. The wound which, when the skin is relaxed, will be somewhat valvular, is then closed by a strip of plaster, and the limb is kept at rest for a few days until it has united. Severe inflammation of the joint less frequently follows this coarse operation than might have been expected, the synovial membrane having probably undergone some modification of action that renders it little liable to this process. It has, however, happened that acute synovitis has set in, and this has terminated in suppuration of the joint, causing the patient's death, requiring amputation, or leading to ankylosis.

It has been proposed by Goyrand, in order to obviate the dangers of direct and open wound into the joint, to remove the loose cartilage by subcutaneous section; this he proposes to accomplish in a way that I have seen practised by Liston, and have often done myself, viz., by passing a tenotome obliquely under the skin after fixing the foreign body in the way that has already been described, dividing the synovial membrane freely, and then squeezing the cartilage into the cellular tissue outside the joint, where it may be allowed to remain until removed by a fresh incision after that in the synovial membrane has healed, or, better still, may be left to be eventually taken up by the absorbents of the part.

A most useful modification of this method has been practised by Mr. Square of Plymouth; it consists in fixing the loose cartilage, dividing the capsule subcutaneously over it, and then pressing the foreign body into the opening thus made, retaining it there by a compress and plasters. Adhesion speedily ensues, and the loose cartilage is eventually absorbed. In operating by this method on the knee, the cartilage should be fixed below and to the

inner side of the patella, between it and the head of the tibia; a long narrow tenotome is then introduced obliquely under the skin from a distance of about two inches below the loose cartilage; the capsule of the joint is divided, the subcutaneous cellular tissue freed by a slight sweep of the blade, and the loose cartilage then pressed into the cavity thus made to receive it, where it may become absorbed. By the adoption of these subcutaneous methods there will be but very little danger of inducing undue inflammation in the joint, the entrance of air being prevented, which, and not the mere section of the capsule and synovial membrane, constitutes the chief risk. Should there be more than one loose cartilage, the operation must be repeated, but not until the inflammation induced by the former one has been subdued. In this way I have successfully removed in succession five loose cartilages from one knee.

NEURALGIA OF JOINTS.

Pain of a severe character is often experienced in or around a joint, closely simulating, but not dependent upon, inflammation or other structural disease. This pain, which is purely neuralgic, may either have its origin in some local irritation of a nerve leading to the sensitive part, or it may be dependent on constitutional disorder of an hysterical character. It is this class of cases, occurring in young women who are either the subjects of hysteria, or are of a highly nervous temperament, that should especially be considered as *Neuralgia of the Joints*, to which the attention of the profession has principally been directed by the labours of Sir B. Brodie.

In these cases it is generally found that the hip, knee, ankle, or shoulder is the joint affected—the hip and the knee more especially. The neuralgia is usually localised in a particular joint by some slight injury that the part has sustained. But it is important to observe that in these cases the pain often does not develop itself for some days, or even weeks, after the injury that is the alleged cause of it. Severe pain is complained of in the joint; and it is rendered comparatively useless, often with a good deal of distortion or contraction. On examination, it will be found that the pain, which is commonly very severe, is superficial and cutaneous, not existing in the interior of the articulation, nor increased by pressure of the articular surfaces against one another; and that it is not strictly confined to the joint, but radiates for some distance around it. This pain is often intermittent in its character, and is frequently associated with neuralgia elsewhere, as in the spine; and not unfrequently with uterine irritation or disease. At the same time, it will be observed that all the signs that ought to accompany a severe attack of inflammation in a joint, such as would be attended by a corresponding amount of pain, are absent; there being no painful startings of the limb at night, no heat, redness, or swelling of it, nor constitutional fever and irritation; and the suffering being increased by causes, such as mental and emotional disturbance, that do not influence organic disease. Attention to these various circumstances will usually enable the surgeon to diagnose the nature of the attack without much difficulty; the only cases in which he will really experience any, being those in which the tissues around the joint have been thickened, indurated, and altered in their characters by the application of issues, moxæ, &c.; or by some slight articular disease having at some time existed, but been cured.

TREATMENT.—The treatment must be of a constitutional character, directed especially to re-establish a healthy condition of the uterine organs. If there be amenorrhœa and anæmia, alopecia and the preparations of iron must be given; if uterine irritation or ulceration exist, this must be

proper local means, and the general health attended to. General nervous antispasmodics and tonics, such as valerian and bark, or assafoetida and quinine in full doses, should be freely administered. The most efficient treatment that can be directed to the affected joint, is, I think, the application of cold douches and the employment of electro-magnetism, which I have found to cure cases in which all other means had failed; the application of atropine and aconite may be of service to allay the pain when especially severe. If contraction or other distortion of the limb exist, the patient should be put under chloroform, and extension or rectification of faulty position then made, care being taken to keep the limb on splints in a proper position for some time after the operation.

CHAPTER XLIX.

EXCISION OF JOINTS AND BONES.

To the surgeons of this country is undoubtedly due the merit of originating and carrying out the practice of excising diseased joints and bones with the view of saving a limb, by the removal of those morbid structures that would otherwise have necessitated amputation. Although the older surgeons, dreading amputation on account of the difficulty they experienced in arresting the hemorrhage from a stump, had recourse to various gouging, scooping, and scraping operations in cases of diseased bone, yet they never attempted the excision of a joint, nor indeed the resection of a whole bone. The articulated ends of bones were first excised in a compound dislocation of the elbow as far back as 1758, by Wainman of Shampton, and afterwards by White, Bent, and Orred in cases of compound dislocation of the humerus. In 1762, Filkin of Northwich excised the knee for disease; and in 1773, Justamond cut out the olecranon and two inches of the ulna for diseased elbow-joint. The first distinct publication on the subject was by Mr. Park, in the year 1782; his object was to show that, in some of those affections of the knee and elbow for which amputation had hitherto been considered indispensable, surgery possessed another resource "in the *total extirpation of the articulation*, or the entire removal of all the bones which form the joint, with as much as possible of the capsular ligament." In the same year Moreau excised the ankle-joint, and some years subsequently the head of the humerus and the knee-joint. The new practice made few converts, however; and in 1805, Mr. Park in another publication expresses his mortification that it had not met with the success in this country that it deserved; and observes that, if it had not been for the Moreaus in France, it would have fallen into complete oblivion. Although excisions continued to be occasionally performed, it was not until a quarter of a century later that they were again prominently brought before the profession; and the second revival was due to the Edinburgh surgeons, chiefly to Liston and to Syme. Since then, they have continued to gain in favour, and now constitute that department of surgery which has been termed the *conservative*, or more correctly the *preservative*.

Before proceeding to discuss the different resections in detail, we must endeavour to lay down some general rules for their performance in those cases in which they are alone admissible.

INDICATIONS FOR EXCISION.—The excision of an articulation may be practised for the following reasons:—

1. As a substitute for amputation in cases in which the joint is so extensively diseased, that the patient will be worn out by the discharge or pain, unless it be removed. Here an useful limb may be secured by the sacrifice of the diseased part.

2. In some cases of articular disease in which amputation would not be practicable, excision may be done in order to hasten the cure, and thus to save years of suffering to the patient.

3. Excision may be done in cases in which amputation is not practicable; as in disease of the hip-joint or of the temporo-maxillary articulation.

4. As a substitute for other and less efficient treatment, in order to restore the utility of a limb or joint; as in osseous ankylosis of the elbow, or in osseous ankylosis of the knee.

5. Excision may be required in bad compound dislocations and fractures of joints, especially in gun-shot injuries; more particularly in those of the head of the humerus, and of the elbow.

As a general rule, resections are more required for diseases of the articular ends of bones than for simple disorganisation of joints. If only the soft structures of a joint be involved, it usually happens that, without the necessity of resection or operation of any kind, an useful limb will result; in the upper extremity, with fair mobility of the articulation; in the lower, with more or less complete ankylosis, sufficient for a fair basis of support. But when the constitution is very strumous, or the bones are primarily or extensively affected, we can scarcely expect that the limb will recover to such an extent as to become useful.

CONDITIONS OF SUCCESS.—For resection to succeed, the following conditions appear to me to be necessary.

1. The disease should not be too extensive, so that its removal would entail such an amount of mutilation of the limb, as to render it less useful to the patient than an artificial member would be. This is especially important in the lower extremity. If the bones be so extensively affected as to require to be shortened by a considerable extent—for several inches—a limb would be left, which, instead of serving as a proper basis of support to the patient, would only be an useless incumbrance. In the upper extremity, length and strength are of less consequence than in the lower; the preservation of the hand is the chief thing to aim at, and if this be effected the bones may be encroached on to a greater extent than is proper in the lower limb.

2. The disease for which resection is practised should be allowed to become chronic before any operation is undertaken: for this there are two reasons. First, in the acute stage of disorganisation of a joint, it is not always possible to say, however unpromising the case may appear, whether ankylosis may not result, so that as useful a limb would be left as could be obtained by resection. And, secondly, if the joint be excised whilst acute and active disease is going on, inflammation and diffuse suppuration of the medullary canal are apt to set in—a condition very apt to be followed by phlebitis and pyæmia. In the only fatal instances of resection of the elbow-joint that I have witnessed, death resulted from this cause; the operation having been performed whilst the articular affection was acute.

3. The soft parts about the joint must be in a sufficiently healthy state. There are two morbid conditions connected with the soft parts that may interfere with the success of resection. First, they may be so thinned and perforated by sinuses, and so adherent to the bones, that an insufficient covering would be left. Or, secondly, the long-continued existence of strumous disease in joints and bones may give rise to a great deposit of slowly organised plastic matter around the articulation. This material

becomes insusceptible of healthy organisation, and slowly suppurates. Sinuses form in it, the integuments covering it become blue and doughy, and the soft parts around the seat of operation fall into a state of strumous disorganisation that prevents alike the formation of a false joint, of osseous ankylosis, or of the healing of the wound, and thus leads inevitably to the ultimate amputation of the limb. Even though this exudation-matter do not exist in large quantity, if the joint be peculiarly loose, owing to softening and disorganisation of ligamentous and tendinous structures, excision is not very likely to succeed, especially if it be the ankle or knee that is removed.

4. *The state of the patient's constitution* must necessarily influence the surgeon materially in his determination whether to resect, or to amputate. If the constitution be tolerably sound, or if the general health have given way, provided that it has done so as the simple consequence of pain, irritation, and continued discharge, resection will have a fair prospect of success. In fact, when the patient is hectic in consequence of continued suppurative action, the removal of the joint or bone that maintains such action may be advantageously practised. But if there be a state of irritative fever in consequence of continuance and spreading of morbid action, the operation is likely to occasion erysipelas, phlebitis, or pyæmia, and is not a safe measure. So also, if the constitution appear to be very much broken down, the patient being anæmic, wasted, and cachectic, with some irritative fever, but with no open abscess in connexion with the joint to account for the cachectic condition, excision of the larger joints, as of the knee and hip, is not a desirable operation. If the patient be very highly strumous, or decidedly phthisical, there will be little prospect of his being able to bear up through the long convalescence that follows resection. A slight degree of pulmonary disease, however, which appears to be rather the result of the long-continued irritation of the local affection, than of any constitutional taint, need not be a bar to these operations. In such cases, I have several times had occasion to observe that the general health improved rapidly after the removal of the local disease.

5. *The extremes of life are unfavourable to resections.* In very early childhood, these operations are seldom necessary; the natural processes usually sufficing, with very little assistance, to eliminate diseased bone, and the disorganised joints admitting readily enough of ankylosis. If the disease be too severe for this, it will usually be found to be associated with so strumous a constitution as to interfere with healthy reparative action of any kind. Another serious objection to these operations in young children is, that should the epiphysis be removed, the development of the limb will be arrested to a great extent, if not entirely. At advanced periods of life, destructive joint disease is not very common, and when it does happen, it is generally in constitutions not fitted to stand up against the prolonged drain consequent on these operations. It is at the early adult age when the diseases most frequently occur that render resections necessary, that these operations are best borne.

REPAIR AFTER EXCISION.—The mode of repair after resection differs according to the circumstances of the operation.

When a bone, as the os calcis, has been entirely removed, it is never, of course, regenerated, but its place is occupied by a firm fibrous cicatrix.

When partial excision of a bone is practised, the result varies according to the tissue that is removed. If a portion of the compact tissue have been cut away, callus is thrown out. If it be the cancellous structure that is scooped out, the cavity left is filled up by a dense fibrous mass which may eventually ossify.

When a joint has been excised, either osseous or ligamentous ankylosis may take place; and the surgeon should endeavour to secure osseous union in some cases, fibrous in others. Thus, when the knee has been excised, as a sound and firm limb is desirable, osseous ankylosis should, if possible, be brought about; whilst in the upper extremity, where mobility is of more use than strength, ligamentous union is most desirable. In these cases the ends of the bones become rounded, and are united by a dense mass of fibrous tissues which envelopes them, and to which the insertions of those muscles that are naturally connected with the articular ends that have been removed become attached.

The question as to the arrest of the development of the bone, and consequently of the whole limb on which an operation of excision has been performed, is one of great practical moment. It is well known to physiologists that the longitudinal growth of a bone is chiefly carried on through the medium of the layer of cartilage by which the epiphysis is attached to the shaft, and which does not become ossified until the bone has attained its full length. It has further been pointed out by Dr. Humphry, that the two epiphyses of the long bones of the limbs do not take an equal share in this development, but that one is a more active organ of growth than the other. Thus the upper epiphysis in the humerus and tibia, the lower epiphysis in the radius and femur, are the most important in this respect. If, therefore, in an excruciating operation practised on a growing child, in whom osseous development has not fully taken place, the whole of the epiphysis be removed, the subsequent growth of the bone, and necessarily of the whole limb, will be arrested proportionately to the share that the epiphysis which is so removed takes in the development of the bone. And if that epiphysis on which the length of the bone is chiefly dependent, be removed—as, for instance, the upper epiphysis of the tibia and humerus, or the lower epiphysis of the thigh-bone—the limb will continue undeveloped and useless for the rest of life.

In the adult, after ossification is completed, the epiphysis loses its importance as an organ of growth; and may be removed, if necessary, without interfering with the subsequent length of the limb, except to the extent of its removal.

INSTRUMENTS.—The instruments required for resection are of a somewhat varied character; strong scalpels and bistouries, straight and sharp-pointed. In addition to these I have found a strong-backed, probe-pointed bistoury with a limited cutting edge, of great utility in clearing the bones. The pliers should be of various sizes and shapes (Figs. 229 to 232), and gouges will be found useful for scooping out suspicious patches on the cut osseous surfaces. For ordinary purposes, a small amputating saw will, I think, be

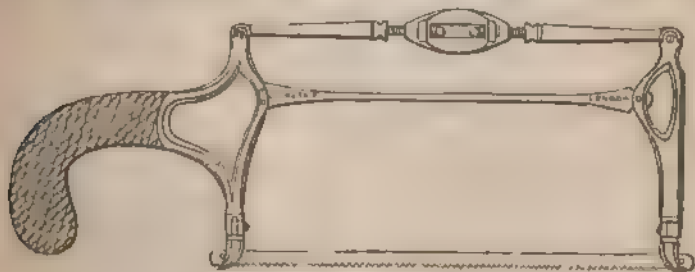


Fig. 240—Butcher's Saw.

found the most convenient instrument for dividing the bones; but in some cases a narrow keyhole saw, or that introduced by Butcher (Fig. 240),

will answer best. The last instrument is especially useful when it is intended to cut the bone obliquely, or when the space is limited; for, as the blade is narrow and its angle can be changed at pleasure, any required direction can be communicated to the cut. I invariably use it in preference to all others in resections. The chain-saw is perhaps not used so frequently as it might be.

OPERATION.—The steps of the operation must of course vary with the different resections; but there are some general rules that may be laid down as applicable to all cases.

1. The incisions through the soft parts should be sufficiently free to expose thoroughly the bones to be removed. By making them, as far as practicable, parallel to tendons, blood-vessels, and nerves, parts of importance may readily be avoided.

2. As little of the bone as possible should be removed. The gouge may be applied to any carious or tuberculous cavities or patches that appear upon the surface of the freshly cut bone; and, in this way, shortening of the bone by the saw may be materially avoided.

3. In young children the epiphysis should never be entirely removed, as it is on the growth of this portion of bone, or rather on that of the epiphysal cartilaginous layer adjoining the shaft, that the development of the bone in length is mainly dependent.

4. In adults in whom the bone has attained its maximum longitudinal development, the epiphysis may be more freely removed, if necessary. But the shaft should not be encroached upon if it can possibly be avoided, and especial care should be taken not to open the medullary canal.

5. It is of great importance not to confound bone softened by inflammation, but otherwise healthy, or roughened deposits of new osseous matter, with that which is carious or necrosed.

6. Skin, however redundant, should seldom if ever be cut away. The flaps, at first too large, soon shrink down to a proper size, and, if trimmed, are very apt to become too scanty.

7. After the operation, light dressings only should be used. As healing always takes place by granulation, no accurate closing of the wound is necessary, but it is sufficient to lay the limb on a pillow, or well padded splint, and to apply water-dressing. When it begins to granulate, more accurate attention to position is required.

8. The constitutional after-treatment should be of a nourishing or stimulating character. As there will be a great drain on the system, and a prolonged confinement to bed, the strength must be kept up under it by good diet. These operations are always of a serious character; in many cases fully as much so as the amputation of a corresponding part, or even more so, owing to the large wound that is often inflicted in the more extensive division of the bones; to the necessity of making the incisions in the midst of diseased or injured structures; and to the more prolonged character of the after-treatment. Hence it is of especial importance that the general health should be carefully maintained after these operations.

9. Should caries or necrosis return after the operation, *secondary reaction* may be required. This I have done successfully at the hip, shoulder, and elbow-joints. In the elbow, in one case I performed a third resection with perfect success; the two previous operations, which had been performed by other and different surgeons, having failed. The success of these secondary resections will necessarily be greatly dependent on the possibility of establishing an improved state of the patient's constitution.

EXCISION OF SPECIAL JOINTS AND BONES.

SHOULDER-JOINT.—Excision of the shoulder-joint may be required for two conditions: 1. Disease, and 2. Compound and Comminuted Fracture of the articulation.

1. *Excision for Disease.*—For disease, excision is not so commonly required as in any other articulation; disease of this joint not being of very frequent occurrence, and, when it happens, often terminating in false ankylosis, without suppuration taking place. When abscess and necrosed bone are met with about the shoulder, it will frequently be found that the coracoid or acromion processes, or the scapular spine, are at fault rather than the joint itself, and extraction of the sequestra formed there may prevent excision of the articulation. In some cases a small sequestrum lying in a carious cavity in the head of the humerus may be removed by sitting up sinuses, without the necessity of excising the head of the bone. When excision has been practised for disease of the shoulder joint, it has usually been for strumous disease, commencing in the head of the humerus, especially in children and young people.

Operation.—The articulation may most readily be exposed by making a semilunar flap about three inches in length, commencing at the posterior part of the acromion, cutting across the line of insertion of the deltoid, and carried up to the inner side of the coracoid process. Or the surgeon may adopt T, J, or Π-shaped incisions. I think, however, that the elliptical, or U-shaped is preferable, as less muscular fibre is sacrificed by it. By a few touches of the scalpel, a large flap composed of the deltoid muscle may be raised, and the diseased articulation fully exposed. As the capsule and the ligaments are destroyed by the morbid action that has taken place in them, the head of the bone may readily be turned out of the glenoid cavity; and, being freed by a few touches of the knife, and isolated by passing a spatula behind it, may be removed with a narrow saw (Fig. 250). In doing this, the shaft of the humerus should be encroached upon as little as possible, not only that the bone may not be shortened more than is necessary, but in order that wound of the circumflex arteries may be prevented, which will certainly happen if the incision be carried too low down. After the removal of the head of the bone, the glenoid cavity must be examined; if this be carious, it may be removed most conveniently by means of gouge-forceps and the gouge, care being taken that all diseased bone is thoroughly scooped away. After the operation, the flap must be laid down, and retained in position by two points of suture, and the arm well supported in a sling, the elbow especially being raised.



Fig. 250.—Excision of Shoulder joint

Result.—The wound unites by granulation, and, though the deltoid muscle does not recover its full utility, a very excellent limb and most useful forearm and hand are left to the patient. The accompanying drawing (Fig. 251) has been taken from a man whose shoulder-joint I removed some years ago. I last saw this patient about seven years after the operation had been performed, and then found that the upper end of the humerus had been drawn up underneath and between the acromion and coracoid processes,

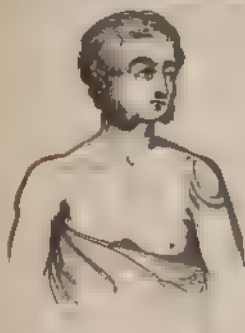


Fig. 251.—Result of Excision of Shoulder-joint.

where a false joint had formed. The arm was extremely useful, and all the parts below the elbow were well developed. The upper arm was two and a half inches shorter than the other. Excision of the shoulder-joint is on the whole a very successful operation. It is true that Velpeau has recorded thirteen deaths after its performance, but even this number would probably give but a small percentage on the number of cases in which it has been done; and an improved acquaintance with the principles of conservative surgery has doubtless still further very materially lessened the mortality.

2. *Excision for Compound and Comminuted*

Fracture.—When excision of the shoulder-joint is required for compound and comminuted fracture from gun-shot injury, the operation is of a less formal character. The bullet-holes must be laid freely open, or the deltoid cut across at its superior attachment, all loose splinters removed, and the ragged and spiculated ends of bone cut off with pliers or saw; especial care being taken in manipulating towards the inner and under sides of the joint, in the vicinity of the plexuses of nerves and large vessels. This operation has been attended by the most satisfactory results; Baudens relates 14 cases occurring in the Crimea, with only 1 death; and in the British army, of 14 cases, 12 recovered.

SCAPULA.—The scapula has occasionally been excised in part, or entirely, for gun-shot injury or disease. Most commonly the operation has been practised after the arm has been removed at the shoulder joint, the state of the scapula requiring its ablation at a later period; this I saw admirably done several years ago by Mr. Fergusson. Occasionally, however, the scapula has been excised without previous amputation of the arm. Thus Liston removed three-fourths of the bone for a vascular tumour springing from it. South excised the whole of the body of the scapula by sawing through its neck; and Jones of Jersey and Syme have taken away the bone with its processes entire. Operations such as these are rarely required, and when called for can scarcely be performed in accordance with any positive rule, the operator varying the extent and arrangement of his incisions according to the extent of the disease, the situation of sinuses, &c. In whatever way they are practised, there is one rule, however, which should be attended to; viz., that the axillary border of the bone should be the last to be interfered with, on account of the hemorrhage that may be expected from this situation.

CLAVICLE.—The clavicle has been partially or wholly excised by Travers, Mott, and others. In caries or necrosis of this bone, portions of it may be gouged away or extracted without much difficulty; but when, in consequence of the growth of tumours, the removal of the whole or greater part

If the bone is required, the operation is one of the most hazardous in surgery, as a glance at the anatomy of the parts lying beneath the bone, and approached upon by the morbid growth, will indicate. In Mott's case, forty ligatures were applied. In this operation, the bone requires to be exposed by a free incision along its whole length: it is then sawn across or disarticulated at its acromial articulation, and carefully dissected out in a direction from without inwards, the sternal end being forcibly twisted outwards, and its ligamentous connections carefully divided. The sternal end only of the clavicle has been excised by Davie of Bungay in a case in which dislocation backwards had resulted from deformity of the spine, and the luxated end, gradually pressing upon the oesophagus, threatened the life of the patient. The bone was cut through by means of a Hey's saw about an inch from its sternal end, and the sterno-clavicular ligaments having been divided, the portion of bone was forcibly elevated, and at last extracted.

ELBOW JOINT.—Excision of the elbow-joint has been more frequently practised than that of any other of the articulations, and the result has upon the whole been far more satisfactory. This operation may be required, 1, for Chronic Disease of the Joint; 2, for Osseous Anchylosis; and 3, for Compound Fractures and Dislocations.

1. In cases in which the elbow-joint requires to be excised for *strumous disease* in young persons it will generally be found that, after morbid action has existed for a considerable time in the joint, the limb will have become useless, and the soft parts around the joint swollen, spongy, and perforated by fistulous openings. When disease of this joint occurs in the middle aged adult, the mischief will usually be found to be principally seated in the bones, the articular structures being only secondarily involved. In these cases there will often be very little external evidence of mischief, merely one or two fistulous apertures leading down to carious or necrosed bone in the condyles or the olecranon, the joint being permanently flexed and swollen, and the arm so useless that it cannot support the weight of the hand. On exposing the articulation, perhaps caries, with complete destruction of the cartilage, with or without necrosis of the articular ends, and with loose pieces of dead bone lying in the cavity of the olecranon, or in one of the condyles, may be found. Most commonly the radius is the last bone that is affected, the ulna and the articular end of the humerus being generally first diseased.

2. If *osseous anchylosis* have occurred, whether in the straight or with bent position, excision or simple division of a portion of the consolidated bone may advantageously be practised. When the elbow is anchylosed in the straight position, the arm is quite useless; and any operation by which flexion of the limb can be obtained, even without mobility of the joint, will add most materially to the patient's comfort, rendering the hand available for most purposes of life. In cases of *angular osseous anchylosis* of the elbow, the bony union should be sawn across or a wedge-shaped piece removed, so that a useful and moveable articulation may be substituted for one that is rigid and fixed.

3. In cases of *compound fracture or dislocation* of the elbow-joint, more or less complete resection of the protruding, and possibly splintered fragments, may be required (pp. 260 and 310).

Operation. Excision of the elbow-joint may be performed by three different procedures, viz., the H, the T-shaped, or the simple longitudinal incision. Each method has its advocates. The H-shaped operation consists in making an incision parallel to, and a little to the radial side of, the ulnar

nerve, another along the outer side of the joint, and uniting the two by a cross cut, dissecting up and down two square flaps, and clearing the bones laterally. It was soon found by surgeons that by this method a very unnecessary amount of incision was practised; and accordingly the vertical cut along the outer side was dispensed with, and the \neg -shaped operation necessarily adopted. This consists in making the longitudinal incision parallel to, and a little to the radial side of the ulnar nerve, and the cross cut over the olecranon to the outer side of the joint. More recently still, it has been found that this incision may be still further simplified, and that the cross cut may be entirely done away with, and the operation reduced to a single longitudinal incision carried nearly over the centre of this joint in the middle line from above downwards. In comparing these different methods of operating, I decidedly give the preference to the single longitudinal incision, as being quite sufficient in all ordinary cases for the complete and easy removal of the articulation. Should the soft structures towards the outer side of the joint not yield sufficiently, a cross cut can at once be made, so as to liberate these, and give the surgeon more room, by turning up the two triangular flaps that will thus be formed.

The following is a detail of the successive steps of the operation as practised by the \neg -shaped or the single longitudinal incision. The patient having been laid prone, the perpendicular cut should be made parallel to, and a line or two to the other side of, the ulnar nerve; being commenced at least two inches above the point of the olecranon, and carried down to about three inches below it. The transverse incision may then, if necessary, be



Fig. 252.—Excision of Elbow joint \neg -shaped Incision.

made directly across the end of the olecranon, to the outer side of the joint, and extended as far as the extremity of the outer condyle (Fig. 252). The two triangular flaps thus made must be dissected up, the knife being carried close to the bones. Or the transverse incision may be dispensed with, and the bones readily exposed and turned out by the third method, that of the

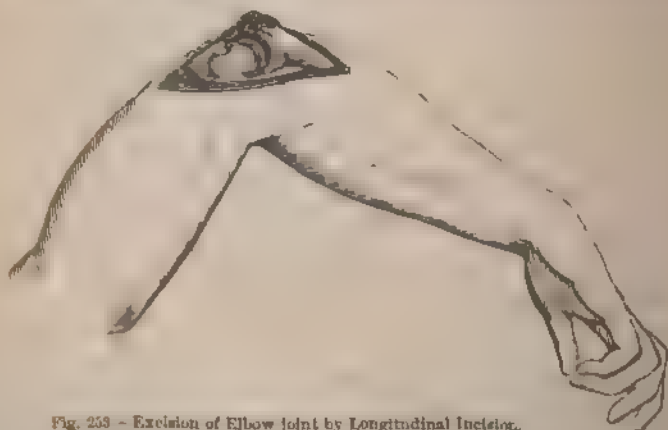


Fig. 253.—Excision of Elbow joint by Longitudinal Incision.

single perpendicular incision (Fig. 253). This must be of sufficient length to allow of the sides being held well apart, and then it constitutes the

simplest plan of excising the elbow that can well be devised, bones have been fairly exposed, they must be cleared to the inner joint in carrying the incision in this direction, the edge of the knife should always be kept against the bones, and their sinuosities closely followed, so that the ulnar nerve, being dissected out from behind the inner condyle, may escape injury. If the incision be properly planned, and the knife kept in contact with the bone, the nerve ought not to be exposed during the operation, more particularly as it is usually imbedded in a quantity of plastic tissue. When the posterior part of the joint has been laid bare in this way, the knife should be carried round the tip of the olecranon, and this process removed with cutting pliers. By forcibly bending the joint, pushing the forearm upwards, and lightly touching the ligaments with the point of the knife, the interior of the articulation will be fully exposed. By means of a small narrow saw, the articular end of the humerus is separated from the rest of the bone; the upper end of the ulna and the head of the radius may either be removed in the same way, or by means of cutting pliers. There is never any necessity to place a spatula before the bones, as the parts of importance anterior to the joint could not easily be wounded, being completely protected by the brachialis anticus. The ulnar nerve will occasionally, however, be in some danger, and it must be guarded or drawn on one side by a bent copper spatula. In this operation it is of great consequence, so far as the after-utility of the arm is concerned, not to remove more of the bones lengthwise than is absolutely necessary; the shaft of the humerus, for instance, should never be encroached upon, but it will be quite sufficient to limit the excision to the articular surface; should any carious portions of bone extend beyond this, I think it is better to scoop them out with the gouge than to remove them in any other way. The excision of the ulna and radius should not be carried so low as to divide the insertions of the brachialis anticus and biceps. After opening the articulation, a practical question of considerable importance often arises; viz., to what extent the resection of the articular ends should be carried. If they be all diseased, there can of course be no doubt as to the propriety of removing the ends of the three bones. So, also, if the humerus and ulna be diseased, the head of the radius should be cut off on a level with the section of the ulna. But the important point is, whether, in the event of only one bone being implicated, by disease or injury, the surgeon should limit himself to the excision of this alone, or should remove the other two. Formerly, in accordance with the principle of conservative surgery, that diseased or injured parts alone should be sacrificed, I have advocated leaving the healthy articular ends, and only removing that which was diseased; but increasing experience has convinced me that this practice is erroneous, and that, if the joint be only partially excised, ankylosis is more apt to ensue than when the whole of the three articular ends are extirpated. I would therefore advise that, in cases of caries involving the elbow-joint, the whole of the articulation be removed, as well as in those cases in which operation is required in consequence of comminuted and compound fracture of only one of the bones; as, for instance, when the lower epiphysis of the humerus, or the upper end of the ulna only, is the seat of such injury.

In some instances no vessels require ligature, though there may be free general oozing, but most commonly one or two must be tied. In several cases, it is said the bleeding has proved extremely troublesome. This, however, I have never seen. After the operation, the limb should be laid upon pillows, nearly in the extended position, so that the cut portions of bones are in close approximation with one another. If the excision have been

Though a single straight incision, there will be but little if any wound, the flaps falling closely together. If any transverse incision be practised, the edges cannot so readily be brought into apposition. At the end of a week or ten days, when granulations have sprung up, may be put on a slightly bent leather splint, and, as the healing goes on, this may gradually be flexed, until at last it is brought to a right angle. The fibrous union that takes place between the bones will be a more compact and useful false joint will form, than if the articular surfaces be too widely separated in the first instance, and be allowed to unite by a lengthened ligamentous tissue. Until the contraction of the articular surface has fully taken place, and the neighbouring tissues are quite firm, the joint should be supported by one lateral leather splint on the inner side of the arm. The splint should then be removed, the arm put in a sling, and passive motion had recourse to, in order to prevent osseous ankylosis. Should there appear to be, as sometimes happens in children, a special tendency to this, the limb may be laid, before cicatrization has taken place, upon a splint jointed opposite the elbow. Much of the success in the result of excision of this, as of other joints, will depend upon the care and attention bestowed on the after-treatment of the case. The position of the parts and the relation of the bones to one another should be scrupulously attended to, bagging of matter prevented, and exuberant granulations repressed. At the same time, the patient's strength must be kept up by constant attention to diet, fresh air, &c. In this way good ligamentous union will take place. In two cases which I have had the opportunity of dissecting, one sixteen months and the other two years and a half after the



Fig. 254.—Arm after Excision of Elbow Joint.

operation, it was found that the ends of the bones were rounded and firmly united by a dense fibroid or ligamentous structure. In this way a most excellent and useful limb will result, having the four movements of flexion, extension, pronation, and supination nearly perfect, with but little deformity, as may be seen

by the accompanying cut (Fig. 254), which was taken nearly two years after operation from a patient of mine. A coachman, whose elbow-joint I excised, was able to drive, to lift a pail of water, and to do all the duties of his employment, nearly as well as if the arm had been left in its normal condition.

Should recurrence of disease take place, resection may be again resorted to with success. In one case, indeed, which had been unsuccessfully operated on twice by other surgeons, I excised the bones about the elbow for the third time with complete success, removing a considerable portion, nearly three inches, of the necrosed shaft of the humerus and the carious upper ends of the radius and ulna. In this case, which was that of a boy about fourteen years of age, complete recovery took place. He had a most useful arm, regaining the four movements of the joint, pronation, supination, flexion, and extension, and this notwithstanding his being of a most strumous habit of body. Six months after the excision he was obliged to have one thigh amputated for disease of the bone, and he eventually died at the end of two and a half years, of caries of the spine.

Results.—Excision of the elbow-joint, so far as life is concerned, is a very successful operation. I have only lost one patient out of eighteen cases in

which I have done it. The principal danger after this operation arises from diffuse suppuration of the medullary canal of the humerus. I have seen this happen in two fatal cases in the practice of others, phlebitis and pyæmia developing themselves in a secondary manner in both instances; and in a third, in which the patient lost his life, it is probable that death, which was attributed to pneumonia, remotely occurred from the same cause.

The result, so far as utility of limb is concerned, is equally satisfactory. If proper care be paid to the after-treatment, a strong arm, useful for all the purposes of life, with a moveable articulation, will be left, admitting of the four normal movements of the joint, viz., flexion, extension, pronation, and supination. If the whole of the articular ends be excised, and if passive motion be employed, or the limb be kept suspended in a sling merely without splints after a few weeks have elapsed, anchylosis will but very rarely take place. Should there be danger of this occurrence, the patient should be put under chloroform, and forcible flexion and extension employed, or the limb pinned on a splint with a hinge joint and ratchet apparatus, which will shut off its being moved daily by the surgeon; care being taken that it be kept flexed rather than extended. Undue mobility is of but rare occurrence; I have never seen it follow excision for disease, but have met with it in our case—that of a young woman, the lower end of whose humerus was completely disorganised by a fall, and the elbow joint opened. In this case the lower epiphysis of the humerus was excised, together with the articular ends of the ulna and radius. A good recovery took place; but although every care was taken to support the limb on splints, a very moveable joint was left. This I attributed to the whole of the lower epiphysis of the humerus having been extirpated, and the union taking place between its shaft and the bones of the forearm in an imperfect manner.

ULNA OR RADIUS.—One or other of the bones of the forearm has occasionally been excised with advantage, leaving a sufficiently useful limb with good power in the hand. Carnochan of New York and Jones of Jersey have successfully excised the whole ulna. Dr. Butts of Virginia has removed the whole radius. In a woman who was under my care about eight years ago, I also resected successfully the whole radius, with the exception of its articular head, which was sound (Fig. 256); and an useful arm, of which the annexed figure is a good representation, was left (Fig. 255). After a time the hand

gradually inclines towards the radial side of the arm; but, although the articulation between it and the fore-arm is but a slender one, through the medium of the ulna, a very useful member will be left. These operations

do not require any specific rules for their performance; the bone is exposed by a long incision in the direction of, and made by slitting up, the sinuses that burrow amongst the muscles, and is then carefully dissected out from the parts amongst which it lies, especial care being taken to preserve the periosteum and any new bony deposits that may already have been formed. In one case in which the



Fig. 255.—Arm from which Radius has been removed

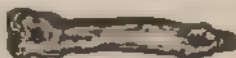


Fig. 256.—The Radius after removal.

elbow-joint was involved, and the radius diseased, instead of amputating the limb I obtained an excellent result by the excision of the articulation as well as of the affected bone. The patient, a builder about thirty years of age, is able now—four years after the operation—to use his hand not only in all the ordinary purposes of life, but also in his trade.

WRIST.—Excision of the wrist is not an operation that has found much favour with surgeons. Most commonly, when the carpus is diseased, the morbid action rapidly extends, with great constitutional irritation, to all the small bones that enter into its formation; and although in some cases a few of these may have been successfully taken away, yet methodical excision of the whole of the joint has not been followed by very satisfactory results, having either been attended by persistence of the disease in the soft parts, or followed by a stiff and useless hand and arm. A great objection to excision of the wrist consists in the superficial character of the articulation, and its close connection with the flexor and extensor tendons; hence, when the wound cicatrises, consolidation of these and of their sheaths is apt to result, and loss of that utility of hand, the preservation of which should be the great object in the performance of the operation, is entailed. I have lately had a case, however, in the person of a middle aged man, in whom the whole of the carpus and a portion of the bases of the metacarpal bones were removed, and who has recovered with a very useful hand, with some power of flexing and extending the wrist, and with very considerable mobility of the fingers. This case is, however, an exception to the general rule, as in the majority of the few instances in which the operation has been done of late years, either an useless hand has been left, or secondary amputation has been required.

Operation.—The operative procedure varies according to the amount of disease. When only a few of the carpal bones are diseased, they may readily enough be removed, through an extension of any fistulous opening that exist over them. But when the lower articular ends of the radius and ulna are implicated, a more formal operation is required; and its performance is attended by some difficulty, on account of the necessity of saving the extensor tendons of the fingers and thumb. Those tendons, however, that are inserted into the metacarpus, such as the supinators, and the radial and ulnar extensors, may be divided; for as ankylosis will, under the most favourable circumstances, result, their preservation can be attended by no useful object; but the extensor tendons of the fingers and thumb should be carefully protected from injury.

The surgeon has the choice of two modes of exposing the radio-carpal articulation. A horse-shoe flap, with its convexity downwards, may be made on the dorsal aspect of the joint, and then dissected up without dividing the extensor tendons of the fingers; the articulation is thus freely exposed; the carpal bones may be removed, and the lower ends of the radius and ulna clipped off. Or a longitudinal incision may be made on either side of the joint, the lower ends of the radius and ulna removed, and the carpal bones that are diseased, extracted. Of the two operations, I prefer the former, as it gives more room; but even by it, the removal of the bones without cutting across the extensor tendons is a troublesome procedure.

HAND.—In the removal of diseased or injured portions of the hand, it is, as a general rule, of the greatest consequence to sacrifice as little as possible of the healthy or uninjured structures. In all operations on the hand, indeed, we must have two great principles in view,—the preservation of the utility of the member, and the maintenance, so far as practicable, of its symmetry. Utility is necessarily the primary consideration; but if a part be not useful,

it may, as in the case of the head of the middle metacarpal bone in amputation of the corresponding finger, be sacrificed for the purpose of preserving the symmetry of the maimed limb. The hand is the organ of *prehension* and of *touch*; and in all operations applied to it we should endeavour, as far as practicable, to maintain its efficiency in both these respects. It is also of importance to bear in mind that two great classes of actions can be carried out by the hand—those that require force, and those that require delicacy of manipulation rather than strength. By a surgical operation we may sometimes succeed in preserving one, though we are compelled to sacrifice the other; and in this respect, our procedure should be a good deal influenced by the occupation of the patient. Thus, by partial excision, we may leave a hand that would enable a clerk to hold his pen, but which would be almost useless to a labourer or blacksmith.

In looking at the hand from a surgical point of view, we may consider it as being composed of two constituents—the hand proper, and the *Thumb*; the thumb being an accessory hand, an opponent to the rest of the member, through the medium of which the movements of ab- and adduction are chiefly performed, and without which the member is susceptible of a comparatively limited utility, being capable of little beyond flexion and extension. Hence the thumb is of equal importance to the rest of the hand: and the preservation of its three bones is as much to be considered as that of the remaining sixteen that enter into the conformation of the metacarpus and fingers. In all cases of injury or disease implicating the thumb, every effort ought to be made for its preservation. Even if it be left stiffened and incapable of flexion, it will be a most useful opponent to the rest of the hand. Should it be found necessary to shorten it, care must be taken that as little curtailment as possible be practised: a portion of a phalanx, or its metacarpal bone even, is of essential utility in giving strength and breadth of grasp to the hand. In cases of disease, a very useful member may be left by the removal of a portion or the whole of the ungual phalanx, of the metacarpo-phalangeal articulation, or even by the excision of the metacarpal bone, the phalanges being left. These various operations are easy of performance; an incision through the diseased and disorganised soft parts will expose the necrosed bone or carious joint, which must be removed by cutting-pliers or a narrow saw.

When the thumb has been forced back or badly lacerated by powder-flask or gun-barrel explosions, it may often be saved by being replaced and maintained in position on a splint, with light watdressing over it; and should amputation be required, it must be done in accordance with the rule just mentioned, of saving as much as possible of the injured part.

In the conservative surgery of the *Fingers*, the preservation of flexion and extension in the part left is the main thing to be aimed at; a rigid stump is always in the way. The preservation of these movements becomes more important in proportion as the palm is approached. It is of more consequence that the proximal phalanx, which carries the rest with it, should be capable of being bent into the palm, than that the distal can be flexed on the second. If the proximal phalanx can be bent down, a very small degree of movement in the distal one will be sufficient to furnish pliability enough in the finger to make it a useful member; but if the proximal one be stiffened, no amount of mobility in the distal phalanx can make it useful.

In preserving these movements, it is necessary to be particularly careful of the sheaths of the tendons. If they be in any way opened or injured, it will generally be found either that the tendon sloughs, or that it becomes con-

solidated, and matted to its sheath in such a way that all movement is lost, or at least greatly impaired.

The only phalanx that can be excised with advantage is the distal one. It often happens, in the destructive disorganisation which results from whitlow, that this necroses ; when, instead of amputating the end of the finger, it may be removed by an incision on its palmar aspect. Disease of the phalangeal articulations usually leads to amputation of the affected finger. The rules for performing these various operations have already been laid down at pp. 33 *et seq.*, to which I must refer the reader.

Resection of the *Metacarpal Bone*, either of the thumb or index-finger, without the removal of the corresponding digit, is occasionally required, more particularly in cases of injury ; it may readily be done by making a longitudinal incision over the dorsal aspect of the bone to be removed, carefully detaching it from surrounding parts by keeping the edge of the knife close against the bone, avoiding the tendons, and then either disarticulating, or (what is preferable) cutting across the neck of the carpal end of the bone, turning it out, and separating it from any distal attachments which it may retain. After the removal of the metacarpal bone of the index-finger in this way, but very little deformity results, and a very useful hand will be left, more particularly in children, on whom I have more than once had occasion to practise this partial resection with success.

CONSERVATIVE SURGERY OF THE LOWER EXTREMITY.—In all conservative operations that are practised on the lower extremity, it is of essential importance that a good basis of support, of sufficient length and sturdiness, be left to the body. These operations differ thus in some important respects from those that are practised on the upper extremity. In the latter, the preservation of the hand, even though in a mutilated condition, is the thing that the surgeon aims at ; and, provided this be attained, it matters comparatively little how much the arm may be shortened or impaired in power. In the lower extremity, however, strength, length, and solidity are essential to the patient's comfort ; and unless these can be secured, his interests are better considered by the removal of the limb, and the adaptation of some artificial contrivance, than by his being left with a shortened, wasted, and crippled member, which is unequal to support the weight of the body.

HIP-JOINT.—Excision of the head of the thigh-bone has of late years been a good deal practised in some cases of hip-joint disease. This operation may, however, most conveniently be considered in connection with that affection (p. 818).

KNEE.—Excision of the knee-joint may be required either as a substitute for amputation in cases of extensive disease and disorganisation of the articulation, or may be practised in some rare cases of faulty ankylosis resulting from old disease or injury, by which the limb has been rendered useless. This operation, originally practised at the close of last century by Park, Filkin, and the Moreaus, fell into disrepute until it was revived in 1850 by Fergusson, since which time it has been extensively practised.

Operation.—Excision of the knee-joint may be performed by making a horseshoe incision with the convexity downwards, from the side of one condyle of the femur across the tuberosity of the tibia to a corresponding point on the opposite condyle (Fig. 257). By this incision the ligamentum patellæ is divided, and that bone turned up in the elliptical flap, the crucial ligaments, if not already disorganised, are then to be cut across, any remaining lateral attachments divided, and the bones cleared for the saw. In doing this the limb must be forcibly flexed, and the knife carefully applied to the

posterior part of the head of the tibia; for this purpose a blunt-pointed resection-knife is the best. The articular surfaces must now be sawn off. This may best be done by Butcher's saw. The lower end of the thigh-bone should first be removed, and then a slice taken off the tibia by cutting from behind forwards, the blade of the saw being turned horizontally; care should be taken not to remove more bone than is absolutely necessary, lest the limb be too much shortened. It not unfrequently happens that carious cavities are found, extending below the level of the section that has been made (Fig. 258): when this is the case, it is better to apply the gouge to them than to saw the bone below their level. It is usually sufficient to remove from one-third to three-fourths of an inch of the tibia, and about one inch or an inch and a half of the thigh-bone (Figs. 259 and 260). Should,



Fig. 257.—Incision in Excision of the Knee joint



Fig. 258.—Application of Butcher's Saw to Head of Tibia.



Fig. 259.—Lower end of Femur, excised.



Fig. 260.—Upper End of Tibia, excised.

however, the operation be required for disease of the limb, consequent upon the deformity resulting from badly reduced fractures or dislocations about the knee, as has been done successfully by Dr. Humphry of Cambridge, it may be necessary, in order to bring the limb into good position, to remove a wedge-shaped piece from one of the bones.

If the patella be much diseased, it must be removed; if it be only slightly carious, it may be scraped or gouged out; and if healthy, in accordance

with that principle of conservative surgery by which no sound part is removed, it should be left, becoming consolidated with and strengthening the joint. The anterior articular surface of the thigh bone, which extends some way up its forepart, may advantageously be sliced off, so as to leave an osseous surface, instead of a cartilaginous one, for the patella to attach itself to.

In some cases no ligatures will be required, but usually two or three of the articular arteries furnish sufficient hemorrhage to require restraint. The patella flap when laid down will often appear inconveniently long and thick; but it is better not to curtail it, unless the bones have been shortened more than usual, as it will contract and eventually fit in well.

I have always found the operation, as it has just been described, easy of performance and good in its results; but various modifications are adopted by different surgeons. Thus, some make one straight transverse incision; others two parallel incisions, one on each side of the patella, or an H-shaped incision, and thus open the articulation from the side. The late Mr. Jones of Jersey, who had great experience in this operation, advised that the skin be dissected up by means of a semilunar incision, and then that the ligamentum patellæ be preserved by being pushed with the patella and the quadriceps extensor tendon to one side, the joint then opened, and the bones sawn. Others advise that the patella be removed; and Holt has recommended that, after the excision, the soft parts of the ham be perforated to allow the discharges to drain through.

The result of the operation will mainly depend on the care taken in the after-treatment. After the operation, the limb should be at once put up securely in a Liston's splint, and well supported. Subsequently, when granulations spring up, it may most conveniently be placed in a long leather trough, extending from beyond the foot to the pelvis, and well padded; particular attention being paid to the position of the limb, and especially to the prevention of any bowing outwards which is apt to take place. In order to prevent displacement, it has been proposed to divide the hamstring tendons; this, however, I have never found necessary, nor does it seem to me to be advisable to complicate the operation by such an addition to it. The protuberance of the flap, if at all excessive, may be diminished by the pressure of a many-tailed bandage. In this way osseous ankylosis will ensue, and a good and useful straight limb result. In two cases I have succeeded in getting a good limb with a partially moveable joint: both these cases were in children; and I am disposed to think that in young patients this result may often be satisfactorily attained. In adults, however, osseous ankylosis should always be aimed at.

Results.—In determining the propriety of performing this operation, there are two points to be considered:—1. The Danger attending it; and 2. The nature of the Result.

1. In estimating the *Danger* of excision of the knee-joint, we must compare the results of this operation with those of amputation of the thigh, as a substitute for which it is performed. No surgeon would think of excising a knee-joint that could be saved by ordinary medical treatment, but would only have recourse to the removal of the diseased articulation in those cases in which its condition did not admit of cure, and would consequently necessitate operation. It is, therefore, useless to institute a comparison between the results of excision of the knee-joint and those of treatment for curable affections of that articulation; but we must compare them with those of amputation of the thigh for incurable disorganisation of the joint.

In 1837, according to Butcher, excision of the knee-joint had been per-

performed 182 times since its revival in 1850. Of these cases 15 proved fatal, and in 4 amputation of the thigh was required, of which 1 case had a fatal issue. In some instances there is reason to believe that the unsuccessful result was owing to want of due attention to the after-treatment of the case. Mr. Price has collected the particulars of 160 cases of excision of the knee performed up to December, 1858: of these, 32 were fatal—8 from pyæmia; and to these must be added 60 cases collected by Mr. Clarke of Bristol, of which 6 died—1 from pyæmia: in all 220 cases with 38 deaths.

The mortality after amputation of the thigh has been given at pp. 30-32. In comparing this with the result of excision of the knee-joint, it will be found that there is no very material difference in the rate of mortality after the two operations.

2 The second point that has to be determined, is as to the *Utility of the Limb* after the operation.

On this point, the result of recorded cases is in favour of the operation. In one of Park's cases, operated on in 1783, that surgeon states that the patient (a sailor), seven years after the operation, "was able to go aloft with considerable agility, and to perform all the duties of a seaman." In some of the later cases the result has been equally good. One of Jones's patients (a boy) "could run and walk quickly without any aid of a stick, could stand on the limb alone, and pirouetted and hopped two or three yards without putting the sound limb to the ground." In several of my own cases an excellent strong and straight limb has been left, useful for all ordinary purposes. In a case which I have lately examined, seven years after the operation, the limb is well nourished, straight, firmly ankylosed, and but very little shortened. The patient, a lad of twenty, can walk eight or ten miles, and even jump and stand on the operated limb without the least pain, sign of weakness, or difficulty. In very young children the result of the operation is not satisfactory, the leg continuing shortened and wasted, not developing with the rest of the body. This is apparently due to and dependent upon the removal of the epiphysis of the tibia, on the integrity of which the growth of the limb is dependent.

After the operation, osseous ankylosis takes place with a firm cicatrix; the limb is shortened from one to three inches, according to the amount of bone removed, but by means of a high-heeled shoe this inconvenience is greatly remedied. It has been urged against excision of the knee-joint that convalescence is tedious and prolonged; but this argument can with justice have but little weight. If an useful limb can be preserved to the patient, it can matter but little if a few additional weeks be devoted to the procedure by which it is obtained; and, indeed, it is a question whether in many cases the patient may not be able to walk just as soon after the excision of the knee-joint as after amputation of the thigh: for, as has been very properly remarked, though the amputation-wound may be healed in three or four weeks, it may be as many months before an artificial limb can be worn.

BONES OF THE LEG.—The *Tibia* is very frequently the seat of caries in the upper and lower epiphyses, and of necrosis in the shaft, requiring partial operation for the removal of the diseased portions. Occasionally a very considerable extent of the shaft, indeed the whole of it, may be removed in a state of necrosis; as a loosened sequestrum, from the interior of the periosteum, more or less consolidated and strengthened by the deposit of new bone. Such operations present nothing special, and the result is usually very satisfactory, the limb that is left being strong, useful, and sound.

The *Fibula* is less frequently the seat of operation, but it, like the tibia,

may require partial removal. In one case, that of a child six years of age, I successfully removed the whole of the necrosed fibula. This operation is



Fig. 261.—Limb with Necrosis of Fibula.



Fig. 262.—Limb after removal of Fibula.

readily done by slitting up the sinuses in a direction so as to expose the sequestrum, which may be then drawn out without difficulty (Figs. 261, and 262). After the operation an inner splint must be applied, in order to obviate the tendency to varus which will ensue. In the case from which the annexed drawings are taken, very considerable reparative action was set up in the periosteum and soft tissues along the line of bone that had been removed, new osseous matter apparently being deposited; and the child, when examined two years after the operation, had an excellent, well-nourished, and useful limb. The foot, however, had a tendency to be drawn inwards, apparently owing to the flexors having overcome the antagonism of the peroneal extensors. This deviation inwards was counteracted by the patient wearing a properly constructed boot, with which walking was perfectly easy.

FOOT.—In looking at the division of the foot into its three great component parts—toes, metatarsus, and tarsus,—we shall perceive that firmness of gait is given by the foot resting on the heel behind, and on the ball in front formed by the projection of the broad line of the metatarso-phalangeal articulations, more particularly that of the great toe; whilst elasticity is communicated to the tread by the play of the toes and metatarsal bones. The elasticity of the foot may be lost without any very serious inconvenience to the patient; but the preservation of stability and firmness of gait are of essential importance; and as these are secured by the heel, the ball of the great toe, and the breadth of the anterior part of the foot, these are the most important parts to preserve in all resections of this part of the body.

In no region of the body have the good effects of modern conservative surgery been more distinctly shown than in the tarsus. In the “good old times” of surgery, if a person had a white swelling of the bones of the foot, or a diseased tarsus, he was at once condemned to amputation of the limb. No distinction was made between disease of the different parts of the foot, nor any attempt to save the sound by the sacrifice of the diseased part.

Until a comparatively recent period, indeed, “diseased tarsus” was described as a whole. Surgeons did not endeavour to make out the exact

extent and amount of the disease, and any case described as "diseased tarsus" was looked upon as requiring amputation of the leg. The rule of practice then observed was, amongst the wealthier classes—those who could afford the expense of a "cork leg"—to amputate a little above the ankle; but amongst the poorer classes, to remove the leg about a couple of inches above the knee, so as to give the patient a stump which, when bent, would fit into the socket of a wooden pin. Thus, in the latter case especially, not only was the leg, itself perfectly sound, sacrificed, but the patient was exposed to great additional danger; for if there be one point more than another which has been indisputably proved by surgical statistics, it is, that the mortality after amputation increases, *ceteris paribus*, in exact proportion as we approach the trunk—every additional inch which we remove augments the danger to the patient. This practice continued to prevail until Chopart drew some distinctions between the treatment to be pursued, according as the disease affected the anterior or the posterior tarsal bones and articulations. He showed, that when the anterior articulations only were affected, amputation at the junction of the astragalus and calcaneum with the scaphoid and cuboid—an operation which goes by the name of "Chopart's amputation"—ought to be performed; thus removing the whole of the disease, and allowing the patient to recover with a shortened foot, with the heel preserved—one on which he could bear the weight of his body, and which would be highly useful to him.

The next step in the conservative surgery of the lower extremity, in cases of diseased foot, was the operation introduced by Syme—that of disarticulation at the ankle-joint. This was certainly a great advance; for, the flap being taken from the heel, the patient has a stump on which he can bear. The operation is also a very safe one. According to Dr. O. Weber, 17 deaths only have occurred in 101 cases of this operation. I have performed it nine times without a death, and this, in the lower extremity, is extremely satisfactory.

Since the introduction of anæsthetic agents, conservative surgery has taken great strides; and I think conservatism in surgery may be regarded as the necessary result of anæsthesia. For, although operations of this kind were performed years ago by Park, the Moreaus, and others, and their utility demonstrated, yet the operations of gouging, scraping, and partial resection were so horribly painful to the patient, and occupied so much time in their performance, that surgeons dreaded to undertake them. Of late years surgeons have learned to discriminate disease of one part of the tarsus from that of another, and to apply appropriate treatment to each.

Looking at the subject in a diagnostic point of view—and the treatment is most intimately connected with the diagnosis—we find that the pathology of diseases of the tarsus is closely connected with its healthy anatomy. Composed, as it is, of seven bones, it presents four distinct articulations. By the term "articulation," applied to the tarsus, I do not mean merely the connection of contiguous bones with each other, but distinct synovial sacs shut off from communication with other synovial sacs in the foot. There are well represented in the diagram on next page (Fig. 243). The posterior calcaneo-astragaloid is the first of them; next comes the (a) anterior calcaneo-astragaloid, the synovial membrane here serving also for the astragalus-scaphoid; the calcaneo-cuboid (b) is the third, and the anterior tarsal synovial membrane (c) is the fourth and largest of all, and the most important in a surgical aspect. It extends between the scaphoid and the three cuneiform and the cuboid bones, between the cuneiform bones themselves, between the two outer cuneiforms and the bases of the second and third meta-

tarsal bones, and also between the external cuneiform and the cuboid. The

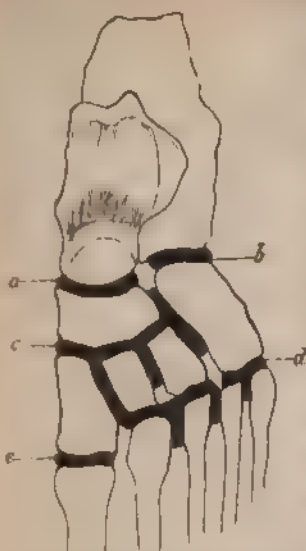


Fig. 263.—Articulations of the Foot

articulation between the cuboid and last two metatarsal bones is shown at *d*; and *e* is that between the internal cuneiform and the first metatarsal bones. These two (*d* and *e*) are not, strictly speaking, tarsal joints.

In the vast majority of cases, so far as my experience goes, it is the osseous structures, and not the articulations, which are primarily diseased. The bones, being cancellous, far removed from the centre of circulation, and exposed to alternations of temperature, readily become the seat of congestion and caries, rarely, however, of necrosis; and in strumous subjects not unfrequently fall into a tuberculous condition. Caries, whether simple or tuberculous, once set up in bones, speedily implicates the articulations secondarily.

Now it is easily understood, on casting an eye on the arrangement of the tarsal synovial membranes, that the extent of disease will, in a great measure, depend upon its seat. Thus, a person may have disease in the os calcis, extending even to the cuboid, with very little likelihood of its proceeding further for a length of time. Such disease will be limited to the outer part of the foot, does not involve its integrity, and readily admits of removal by operation. But let him have disease springing up in the scaphoid, or in one of the cuneiform bones, or in the bases of the second or third metatarsal bones, and the morbid action will rapidly spread through the whole of the anterior and inner part of the tarsus, and, in all probability, no operation of resection can be advantageously employed. Hence the seat of disease influences materially its amount and extent, and the kind of operation required for its removal.

The foot is frequently the seat of strumous disease; to this it is disposed by the alternations of temperature to which it is subjected, by its liability to sprains and injuries, and by the cancellous and spongy structure of its bones, together with its extensive articulating surfaces. When affected by strumous inflammation it becomes painful, the patient being unable to bear upon the toes or anterior ball of the foot. Swelling of an uniform character takes place, with tenderness at some point opposite the bones or articulations that are chiefly involved; and eventually abscess forms, leaving sinuses through which the probe passes down upon softened and carious bone. These evidences of disease are usually much marked about the dorsum and sides, the sole being often comparatively free from disease—an important point in reference to operation.

Strumous disease may commence either in the bones, or in the articulations of the foot. The bones that are most frequently the seat of primary disease are the calcaneum, the astragalus, the scaphoid, the cuboid, and the metatarsal bone of the great toe. When disease is limited to one or two of these bones, excision is usually practicable; but when the morbid action extends, through the influence of the connecting articulations, to other bones of the tarsus or metatarsus, partial amputation will be required.

Primary disease of the articulations of the foot is a less frequent cause of operation than caries of the tarsal bones leading secondarily to an implication of the contiguous articulations; and the particular operation required will, in a great measure, depend upon the extent of implication of the synovial membranes of the foot. When the calcaneo-astragaloid or the calcaneo-cuboid articulations are alone affected, with their contiguous bones, resection of the bones and joints implicated will often be attended by very satisfactory results; but when the large anterior tarsal synovial membrane is in a state of chronic disease, either as the result of primary morbid action set up in it, or secondarily to diseases of the scaphoid, the cuneiform, or of either of the metatarsal bones connected with it, then resection is scarcely admissible, and Chopart's amputation offers the best means of relief. The inflammation of the large and complicated anterior tarsal synovial membrane commonly commences in disease of the scaphoid. It may, usually, readily enough be recognised in its earlier stages by the pain and swelling that take place across the line of articulation between the scaphoid and cuneiform bones, the pain being greatly increased by bending the foot down, and extending across the whole breadth of the foot. For, although it is usually most severe at the inner side, which is the first affected, yet the external section of this complicated articulation, that between the external cuneiform and the cuboid, becoming involved, causes suffering to be experienced on the outer side of the foot as well. In the more advanced stages of this particular disease, the foot assumes a remarkable bulbous or clubbed appearance; the symmetry of the heel and the outline of the ankle are unimpaired, but the forepart and dorsum of the foot are greatly swollen, glazed, and possibly perforated by sinuses discharging thin unhealthy pus. I look upon this disease of the anterior tarsal synovial membrane as a distinct affection of the foot, requiring to be diagnosed from the other strumous inflammations, and in its advanced stages requiring Chopart's amputation.

TARSAL BONES.—Any one of the tarsal bones may be the seat of primary disease, which morbid action may be limited to the bone originally implicated, or may extend to neighbouring articulations, or through the whole tarsus. There are, however, four bones which may be looked upon as the most frequent centres of tarsal disease—viz., the Os Calcis, the Astragalus, the Scaphoid, and Cuboid; and they are commonly affected in the order given. Their diseases we shall now proceed to consider.

The *Os Calcis*, from its exposed situation, large size, and spongy structure, is more frequently the seat of caries and necrosis than any of the other tarsal bones. Very commonly the morbid action is limited to this bone; in other instances it extends into the calcaneo-astragaloid or calcaneo-cuboid articulations.

When the disease is situated in the *posterior or lateral parts of the bone*, the neighbouring articulations are seldom involved, and then the removal of the morbid structures by gouging will usually succeed in effecting a cure. I have frequently had occasion in this way to scoop out great portions, sometimes the whole of the interior of the calcaneum, with the most excellent results. Even when the cuboid is extensively implicated as well, and the calcaneo-cuboid articulation is the seat of diseased action, the disorganised structures may often be removed by gouging and partial resection, as in the case of which the cut (Fig. 264) is a good representation, where, by means of a \perp -shaped incision, these bones were exposed, and their carious portions gouged out. Should, however, the caries have affected the *superior or anterior portions of the bone*, then the implication of the astragaloid or cuboid articulations may render the excision of the whole bone necessary,

as the only means of preventing extension of secondary morbid action to the tarsus generally. So infrequent, however, is disease of the articular



Fig. 264.—Disease of Os Calcis and Cuboid, and of Calcaneo-Cuboid Joint. Lines of Excision.

aspects of this bone, that its complete removal is very seldom necessary. Out of eighteen or twenty cases of caries of the os calcis that have been under my care, I have never had occasion to excise the bone but once; and Fergusson states that he has never yet found it necessary to do this operation. Indeed, excision of the os calcis should not be lightly undertaken. The large size of the bone, its importance as a basis of support to the body, and as the point of at-

tachment to the strong muscles of the calf, should induce the surgeon, whenever practicable, to avoid its complete extirpation, and to limit himself to the application of the gouge, even though he may have to scoop out the whole of the interior of the bone, leaving little more than an osseous shell. This will fill up by the deposit of a dense fibroid tissue, which probably, eventually undergoing partial ossification, leaves the foot as useful as ever for all purposes of support and progression.

Mr. Greenhow, lately of Newcastle, appears to have been the first surgeon who successfully excised the whole of the os calcis. This case occurred in 1848; and since then the operation has been performed in a considerable number of instances in this country and in America, and established as one of the many important developments made by conservative surgery of late years. In France, however, it seems to have found little favour, if indeed, it has been performed. Guérin, one of the most recent French writers on operative surgery, states that excision of the os calcis should not be attempted, and gives as his only reason for describing the operative procedure, that English surgeons have not feared to undertake it.

The operation is a very successful one, and leaves a flat but useful foot. Occasionally, however, after the removal of the bone, disease is set up in the neighbouring parts requiring amputation; this I have seen more than once happen; and of 10 cases collected by Mr. T. M. Greenhow, it became requisite in 2 eventually to remove the foot.

Operation.—Excision of the os calcis is usually performed by turning a heel-flap back, as in disarticulations at the ankle-joint, and then carrying incisions forward into the sole of the foot, by which another flap is turned up, and the calcaneo-cuboid articulation exposed and opened (Fig. 33), after which the knife is carried between the astragalus and calcaneum, and the latter bone detached. By this operation the sole of the foot is somewhat extensively incised, and cicatrices are left over the heel.

In order to avoid this inconvenience, I have found that disarticulation of the os calcis may readily be performed in the following way. The patient lying on his face, a horseshoe incision is carried from a little in front of the calcaneo-cuboid articulation round the heel, along the sides of the foot, to a corresponding point on the opposite side. The elliptic flap thus formed is dissected up, the knife being carried close to the bone, and the whole under-surface of the os calcis thus exposed. A perpendicular incision, about two inches in length, is then made behind the heel, through the tendo Achillis,

in the mid-line and into the horizontal one. The tendon is then detached from its insertion and the two lateral flaps are dissected up, the knife being kept close to the bones, from which the soft parts are well cleared (Fig. 265). The blade is then carried over the upper and posterior part of the os calcis, the articulation is opened, the interosseous ligaments are divided, and then, by a few touches with the point, the bone is detached from its connections with the cuboid. This bone, together with the astragalus, must then be examined; and if any disease be met with, the gouge should be applied. Should anchylosis have taken place between the os calcis and the astragalus, as I have found in one case, the bones may readily be divided by means of Butcher's saw. By this operation all injury to the sole is avoided; and, the open angle of the wound being the most dependent, a ready outlet is afforded for the discharges.

The following drawing (Fig. 266) gives an excellent representation of the state of the foot of a girl before and after the excision of a diseased os calcis—a somewhat flattened but most useful foot resulting:—

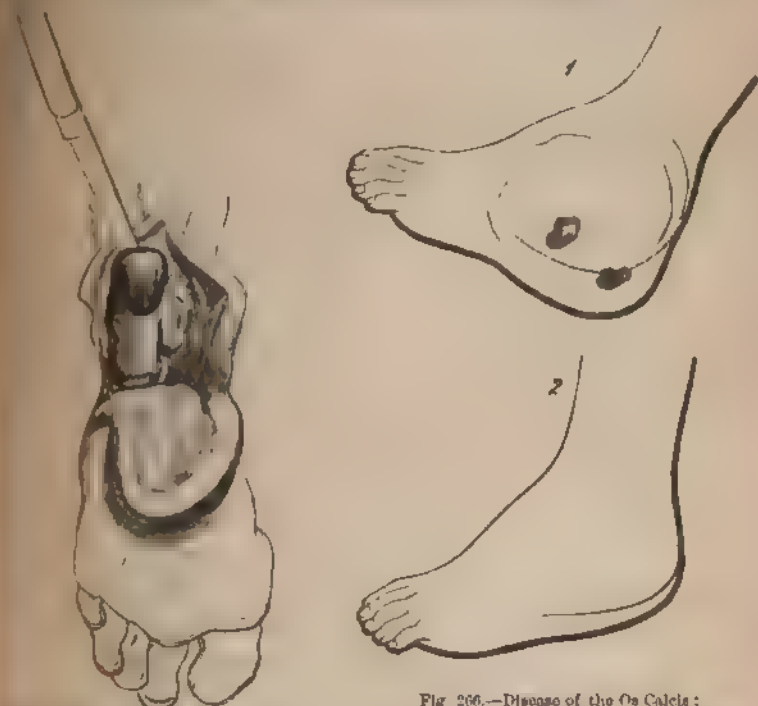


Fig. 265.—Excision of the Os Calcis.

Fig. 266.—Disease of the Os Calcis:

1. Foot before Operation, 2. Foot after Excision.

The *Astragalus* is situated in a position of great surgical importance. Articulating with the malleolar arch above, with the calcaneum below, and with the scaphoid in front—forming, as it were, the keystone of the foot—it is perfectly evident that any morbid action commencing in it is very likely to spread to and involve all the more important structures of the foot. Seldom, indeed, does disease originating in this bone long remain confined to it; and, so far my experience goes, gouging operations, even if performed at an early period, are rarely of much benefit, the morbid action continuing to extend notwithstanding their employment. Indeed,

in diseased astragalus, I believe that excision ought, as a rule, to be practised in preference to gouging, contrary to what is the case in the calcaneum.

Disease primarily originating in the astragalus may spread in three directions: upwards into the ankle-joint, downwards to the calcaneum, and sideways to the scaphoid, and thence through the large anterior tarsal ligaments to the rest of the tarsal bones. The treatment will vary according to the direction and extent of the disease. It may be arranged under two heads.

1. When the astragalus alone is diseased, we find what is seen in the drawing below (Fig. 267), which represents the foot of a boy whose

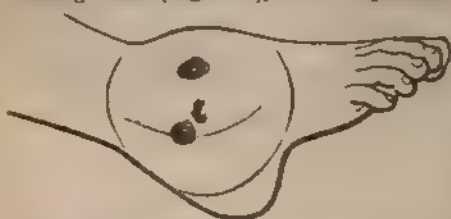


Fig. 267.—Disease of Astragalus.

astragalus I excised—a sinus was in front of the malleolar arch, with fistulous openings leading down to the diseased astragalus; the anterior part of the foot and the heel were quite sound. If the excision be limited to the outer side of the bone, or to its head, it is possible that, by freely opening up the sinuses and applying the gouge, the caries may be entirely removed. But this operation is not so satisfactory here as elsewhere in the foot, as it is by no means easy to avoid opening the astragalo-scapoid articulation; and if this be done, disease will almost inevitably extend through the tarsal articulations. Excision of the astragalus alone, though sometimes required for disease, is perhaps more frequently called for in those cases of compound dislocation in which the bone, having been thrown out of its bed, eventually becomes carious or necrosed. The operation may be done by making an incision across the outer and anterior aspect of the ankle, exposing the bone, cutting across its neck with pliers, and then with strong forceps freely elevating it from its bed and detaching it by the cautious application of the knife, more particularly to the inner side, where the plantar arteries are in danger. If the bone has been dislocated, and its ligamentous connections thus torn through, or if these have been disorganised and softened by disease, it may readily enough be removed as just described. But if the osseous tissue itself be carious and softened, and the ligamentous connections tolerably sound, then the operation becomes extremely troublesome, tedious, and prolonged—the bone breaking down, and having to be removed piecemeal by means of the gouge and pliers. The result of this operation is very satisfactory; a good and moveable articulation may be left between the malleoli and calcaneum, and the limb is but little shortened.

2. When the disease has extended from the astragalus to the malleolar arch, excision of the ankle-joint will be required. This operation may most conveniently be performed in the following way. A semilunar incision, about four inches in length, should be made along the outer and anterior aspect of the joint, round the lower border of the external malleolus (Fig. 268), and should be carried sufficiently forwards to give space without dividing the extensor tendons or the dorsal artery. A perpendicular cut should then be made along the fibula. The peroneal tendons having been divided, the lower end of the fibula should be cut across and detached. The astragalus, which will now be exposed, should then be separated from its connections, which, if they be much diseased, may usually be readily done.

deeply affected, it will be more firmly held, and should then be cut with pliers, and each fragment lifted out of its bed with gouge or

The foot now be well exposed to the inner side of the lower end of the tibia, the tibia being isolated; the tibia being with great care and kept in position, the bone, the posterior artery be

When the ligamentous tissue is attached to the bone have been separated, the

talus may be cut off with bone-forceps, and as much as necessary of the lower end of the tibia removed by a gouge or a chain-saw. Should any disease in the articular surfaces of the calcaneum or scaphoid be gouged away.

It should then be dressed, and the limb in a Laston's splint.

When the disease has spread from the astragalus into the malleolar and downwards into the calcaneum, the line of incision will depend on the extent of the implication of the talus. If the greater part of the whole of this be removed, no resource is left but amputation — resection of the foot.

However, the calcaneum is partly involved, its surface only being diseased, a great deal may be saved by conservative sur-

The treatment in such cases consists, generally, in separating the astragalus from the calcaneum and gouging away the diseased bone which may be either on the upper or under surface of the arch. Very large pieces of bone may be removed from this situation.

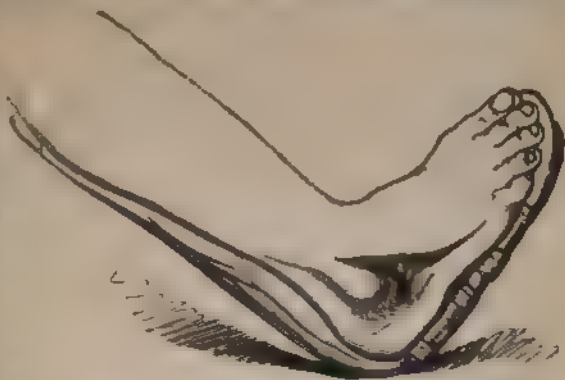


Fig. 268 — Limb after Excision of the Ankle joint.

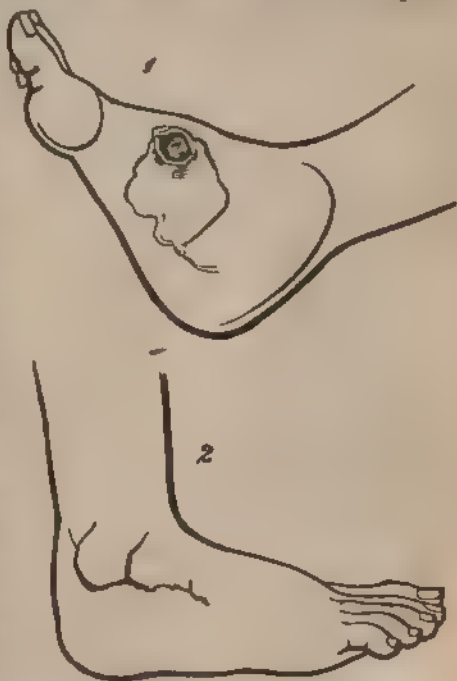


Fig. 269 — Excision of Astragalus.

(1) Foot before Operation. (2) Foot six months after the Removal of the Malleolar Arch, the Malleolus, the Astragalus, and a portion of the Upper Surface of the Calcaneum.

I have taken away the whole of the mal-

leolar arch and astragalus, and gouged out the upper surface of the os calcis very freely; and yet the patient has recovered with a strong and movable foot, but very little shortened or deformed.

The preceding cuts (Fig. 269) are taken from a young man on whom I performed the operation just described. The foot is perfectly movable and strong, and the false joint at the ankle moveable. There are cases, however, in which we find that the disease has extended so far beyond its primary seat, that amputation rather than resection is required. But in the majority of instances, removal of the astragalus and gouging away the upper surface of the calcaneum will suffice.

4. If the disease have extended from the astragalus to the scaphoid, and thence into the anterior range of tarsal joints, the foot will have become extensively disorganised, that partial resection will be of little or no service, and disarticulation at the ankle-joint should be practised.

Excision of the *Cuboid Bone*, either in whole or in part, may be required. Partial excision is here done with the gouge. When the whole of the bone is taken away, the fifth metatarsal bone with the little toe will probably require removal. This may be done by making the flap, as depicted in Fig. 27, only commencing the incision about an inch further back, towards the calcaneo-cuboid articulation, and opening this instead of the metatarsal cuboid.

The *Scaphoid* is very commonly the seat of primary disease; and as this bone is connected in front with the large tarsal synovial membrane, and posteriorly with that which is common to the calcaneo-astragalum and astragalo-scaphoid articulations, the greater part of the tarsus is apt to become speedily involved in the morbid action. It stands, indeed, next to the astragalus in its power of implicating a great extent of the foot in disease. The extent of this implication is such that excision of the primarily diseased bone would probably seldom be attended by much benefit, and Chopart's amputation or disarticulation at the ankle-joint would be necessary.

Next to disease of the astragalus, I look upon strumous inflammation and caries of the scaphoid as most destructive to the integrity of the foot.



Fig 270.—Disease of Cuneiform Bones.

When the *Cuneiform Bones* are the seat of caries, it will generally be found that the middle cuneiform is the bone primarily affected. Thence the disease extends to the lateral and to the bases of the second and third metatarsal bones (Fig. 270). In such cases the anterior tarsal synovial membrane usually becomes extensively implicated, and Chopart's amputation will be required. But if the morbid action continue to be limited to the middle cuneiform and the contiguous metatarsal bone, and the patient's general health be good, removal of the diseased osseous structures with the gouge, with extraction of the caries of the cuneiform, may be attended by successful results.

In chronic disease of the ankle and of the tarsal bones, it will occasionally happen that an excellent and useful foot may be left, after excision, of a less formal kind than those just described. In a lad who was some time since under my care with very extensive

In chronic disease of these parts, I removed the lower three inches of the fibula, and gouged away considerable portions of the end of the tibia and of the astragalus, calcaneum, and cuboid—removing a whole handful of carious bone. yet a perfect cure resulted, the patient recovering with a strong and useful foot. In infants and very young children, disease of the tarsal articulations and even bones may often be recovered from, without the necessity of having recourse to operation, by attention to the child's general health, and by giving the part rest.

The Malleoli alone seldom require resection. Should either of them do so, the operation may readily enough be accomplished, in the outer malleolus, by dividing the bone with cutting-pliers; but in the inner malleolus, more care is required in avoiding the flexor tendons, the artery and nerve, and the bone had better be cut across with a chain-saw. The removal of the outer malleolus, or rather of the lower end of the fibula, is apt to be followed by the inconvenience of a tendency to twist of the foot outwards,—in fact, to a kind of valgus.

The Metatarsal Bones with their Toes occasionally require removal. This is more particularly the case with the first and the fifth (pp. 41, 42). The middle metatarsal bones cannot advantageously be taken away, leaving merely the first and last; but the two, three, or even the whole four of the external metatarsal bones may be advantageously resected, and an useful foot left. Aston Key has recorded a case in which, in consequence of injury, he amputated the four outer metatarsal bones, the cuboid, and the external and middle cuneiform, leaving merely the line of bones supporting the great toe. The first metatarsal bone was left, supported only by the slender articular surface of the internal cuneiform; but it soon got firmer attachments, and a very good foot resulted, by which the patient retained in a great measure his elasticity of tread.

The Phalanges and Articulations of the Toes seldom require resection; as a general rule, their amputation is preferable. The only case with which I am acquainted where resection of a phalanx is required, is when an exostosis has formed under the nail of the toe, pushing it up: here the removal of that portion of bone from which it springs is the best course to pursue.

The Great Toe not unfrequently requires removal, in whole or in part; but, as it enters largely into the formation of the arch of the foot, no more of it should be taken away than is absolutely necessary. It is especially of importance that the ball of the great toe be, if possible, preserved; and occasionally this may be effected by excision of the metatarsophalangeal articulation rather than by the amputation of the member. With regard to the removal of the toe and its metatarsal bone, I must refer to p. 41. Whenever it is practicable, the proximal end of the bone should be saved, in order that the insertion of the tendon of the peroneus longus may be preserved.

AMPUTATION IN JOINT-DISEASES.—In those cases in which excision of the diseased joint is not advisable, in consequence of the acute character of the articular disease, the existence not only of considerable suppuration but of great local and constitutional irritation, or the peculiar nature of the joint affected, amputation may be the sole resource left to the surgeon. It is especially in articular disease of the fingers and toes, of the tarsus, carpus, ankle, and knee, that this operation is required; and though it is much less frequently practised now than formerly, yet the cases of destructive disease of joints requiring amputation are amongst the most frequent in operative surgery, and will doubtless continue to be so. The surgeon, however, must

leolar arch and astragalus, and gouged out the upper surface of the os calcis very freely; and yet the patient has recovered with a strong and moveable foot, but very little shortened or deformed.

The preceding cuts (Fig. 269) are taken from a young man on whom I performed the operation just described. The foot is perfectly useful and strong, and the false joint at the ankle moveable. There are cases, however, in which we find that the disease has extended so far beyond its primary seat, that amputation rather than resection is required. But in the majority of instances, removal of the astragalus and gouging away the upper surface of the calcaneum will suffice.

4. If the disease have extended from the astragalus to the scaphoid, and thence into the anterior range of tarsal joints, the foot will have become so extensively disorganised, that partial resection will be of little or no service; and disarticulation at the ankle-joint should be practised.

Excision of the *Cuboid Bone*, either in whole or in part, may be required. Partial excision is here done with the gouge. When the whole of the bone is taken away, the fifth metatarsal bone with the little toe will probably also require removal. This may be done by making the flap, as depicted in Fig. 27, only commencing the incision about an inch further back, opposite the calcaneo-cuboid articulation, and opening this instead of the metatarsal-cuboid.

The *Scaphoid* is very commonly the seat of primary disease; and as this bone is connected in front with the large tarsal synovial membrane, and posteriorly with that which is common to the calcaneo-astragaloid and astragalo-scaphoid articulations, the greater part of the tarsus is apt to become speedily involved in the morbid action. It stands, indeed, next to the astragalus in its power of implicating a great extent of the foot when diseased. The extent of this implication is such that excision of the primarily diseased bone would probably seldom be attended by much benefit, and Chopart's amputation or disarticulation at the ankle-joint becomes necessary. Next to disease of the astragalus, I look upon strumous inflammation and caries of the scaphoid as most destructive to the integrity of the foot.



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the tumour joints, the question of amputation under these circumstances becomes one of very considerable importance. If the phthisis be rapidly increasing, and there be a strong hereditary tendency to the disease, or if it have advanced to softening of the lung and the formation of vomica, it will be useless to operate. If, however, the phthisis be very slight and incipient, and be apparently due to the local irritation of and discharge from the diseased joint, to the confinement to bed that this necessitates, and to the general deprivation of health that ensues, amputation may not only be safely but advantageously practised; and I have performed it in many such cases to the manifest advantage of the patient.

CHAPTER L.

DISEASES OF THE SPINE.

SPINA BIFIDA.

It occasionally happens that, from congenital malformation, the spinous processes of some of the vertebrae are deficient, and their laminae either absent or separated; in consequence of which, the meninges of the spinal cord are unprotected, and project through the aperture in the bones, giving rise to a tumour at the part where the arrest of development in the osseous structures occurs.

CHARACTERS.—The tumour is usually oval, its long axis corresponding with that of the spine. It generally varies in size, from that of a walnut to an orange; but occasionally it attains an immense bulk, equal to that of a child's head. In some cases the tumour is lobulated, having an imperfect septum stretching across it; in other instances, two or more of these tumours have been met with in the spine. The skin covering it is usually of its normal colour; but when the tumour is of considerable size, it may be thin and have a bluish or congested appearance, and present a certain degree of transparency. In these circumstances, ulceration from distension and thinning of the skin may eventually take place. On examining the tumour, which is hard though elastic when the child is held upright, it will be found that it becomes soft when the child is laid horizontally. It usually becomes tense during expiration, and softer during inspiration. In some cases fluctuation is perceptible, and by pressure the bulk may be lessened.

Spina bifida may be met with in any part of the vertebral column; it is, however, almost invariably found in the lumbar region, the cases in which it appears higher up being of rare occurrence; instances of the kind are, however, mentioned by Cruveilhier. When it occurs higher up, in the cervical or upper dorsal region, it has been found that the spinal cord and nerves are usually adherent to the walls of the tumour; in the lumbar region this is not the case.

The fluid contained in the tumour is of a clear limpid character. It contains chloride of sodium; and, as in the cerebro-spinal fluid, a trace of sugar is generally present.

PROGNOSIS.—The prognosis of spina bifida will depend upon the size of the tumour and on the condition of the skin covering it. If it be of small size, with healthy integumental investment, and without a tendency to increase, the patient may live to an adult age, provided care be taken to protect the tumour. If of large size, it is generally fatal, the child usually

be careful, whilst he avoids continuing to make ineffectual attempts to save the limb at the great hazard of the patient's life, not to amputate until it is clear that all other means have failed; the patient continuing to lose ground so, that a further perseverance in local and constitutional treatment would probably end in his death, excision not being practicable. So far from amputation being an opprobrium to surgery in such cases as these, I look upon it as one of the greatest triumphs of our art, that by a simple and easy operation, which removes the spoiled and useless limb, the life of the patient may be saved, and his health speedily restored.

In amputating in cases of chronic joint-disease, where the limb has been the seat of prolonged suppuration, it will be found, just as in cases of many secondary amputations after injuries, that the condition of the muscles of the limb is peculiar. Instead of, as in cases of primary amputation, being dark in colour and retracting forcibly and unequally when cut across, they will be found to be pale, soft, flabby, and retracting but little if at all; resembling in this respect the muscles in a dead body, with the inter-muscular cellular tissue often infiltrated. In consequence of this alteration in their structure and physiological properties, the flaps need not be cut so long in amputation for chronic suppurative joint-disease as in cases of primary amputation.

Circumstances influencing Mortality.—The mortality after amputation for joint-diseases is specially influenced by three conditions: viz, the seat of the operation, the acute or chronic character of the disease, and the constitutional condition of the patient.

The influence of the seat of operation has already been discussed at p. 28.

The duration of the disease exercises a most important influence, especially in the larger joints—more particularly the knee. As a general rule, it may be stated that, the more acute the suppurative destruction of a joint, the less successful is the amputation of the limb likely to be; pyæmia and low secondary inflammation being especially apt to supervene.

In very acute cases, the surgeon ought to evacuate the pus by means of free incisions, and endeavour to delay the necessity of amputation until the active suppurative stage has passed, and the affection has subsided into a chronic form. In chronic cases, the success of amputation is very great. It commonly happens that a patient who has been racked with pain, and been wasting in body for weeks before the local source of irritation was removed, sleeps soundly the night after the operation, and rapidly gains flesh and strength.

In determining upon the advisability of resecting a diseased joint or of amputating the limb, the surgeon must be guided not only by the amount of disease in the articulation, but by the constitutional condition of the patient. In amputation the chief dangers are immediate—from shock, or secondary hemorrhage. In excision the shock is not so severe, in consequence of the incision being farther from the trunk, and through comparatively superficial and unimportant parts; no large bloodvessels, nerves, or even muscles are divided, and there is no danger of secondary hemorrhage. But in excision the dangers are chiefly remote; the suppurative process is long continued, and the discharge of pus abundant, the patient may consequently not have sufficient constitutional power to carry him through. So far as erysipelas and pyæmia are concerned, the danger is probably the same in both operations. In addition to this, it must be borne in mind that a patient will often consent to have a joint or bone excised who would not agree to part with a limb.

As phthisis not unfrequently co-exists with the advanced forms of

struous joints, the question of amputation under these circumstances becomes one of very considerable importance. If the phthisis be rapidly progressing, and there be a strong hereditary tendency to the disease, or if it have advanced to softening of the lung and the formation of vomica, it will be useless to operate. If, however, the phthisis be very slight and incipient, and be apparently due to the local irritation of and discharge from the diseased joint, to the confinement to bed that this necessitates, and to the general deprivation of health that ensues, amputation may not only be safely but advantageously practised; and I have performed it in many such cases to the manifest advantage of the patient.

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PROGNOSIS.—The prognosis of spina bifida will depend upon the size of the tumour and on the condition of the skin covering it. If it be of small size, with healthy integumental investment, and without a tendency to increase, the patient may live to an adult age, provided care be taken to protect the tumour. If of large size, it is generally fatal, the child usually

there may be no appearance of excurvation. In these cases of caries *without angular curvature*, it will be found that the spine has lost its natural free mobility and flexibility, moving fixedly, stiffly, and as a whole when the patient leans forwards or sideways. The patient, when laid flat on his back, cannot raise himself into a sitting position without the aid of his hands or elbows, and he cannot turn sharply and suddenly over upon his face. Occasionally the incipient curvature, when it occurs, assumes more of a lateral than of an angular direction. The lower limbs now become weak, and the patient walks with a peculiar shuffling tottering gait, the legs being outspread, and the feet turned out. The weakness of the limbs is especially marked in going upstairs, and may be tested by directing the patient to stand unsupported on one leg, and raise the other so as to place the foot upon the seat of a chair, which he will probably be unable to do. The deformity of the spine now slowly increases; the patient becomes unable to stand; and spasms of the muscles of the lower extremity come on, together with a tendency to relaxation of the sphincter ani, and retention of urine.

Abscess now commonly makes its appearance; and in some cases it occurs before any of the other signs except pain and weakness of the spine, but certainly before any deformity has taken place. When the abscess forms, as Stanley has observed, the pain and irritation of the spinal cord are usually lessened for a time.

It must not, however, be supposed that abscess necessarily forms in all cases; indeed, the formation of matter will, I believe, chiefly depend upon whether the disease of the vertebrae be tuberculous or not. Simple congestive or inflammatory caries of the spine may take place to a very considerable extent, and yet no suppuration occur; the bodies of the vertebrae undergoing erosion and absorption, and coalescing so as to become fused together into one soft and friable mass of bone, across which bridges of osseous tissue are sometimes thrown out, so as to strengthen the otherwise weakened spine. In these cases, masses of porcellaneous deposit will not unfrequently be found intermixed with and adherent to the carious bone. Indeed, this anchylosis and fusion of the bodies of the diseased vertebrae may be looked upon as the natural mode of cure of angular curvature of the spine; the only way in which it can take place when once the disease has advanced to any considerable extent.

When abscess forms in connection with diseased spine, it is probably the result of the continued irritation produced by the tuberculous deposit; and it may become the most prominent and marked feature of the affection, giving rise almost to a distinct and independent disease. The situation and course of the abscess depend entirely upon the part of the spine affected; thus, for instance, when the cervical vertebrae are diseased, the abscess may come forwards behind the pharynx, and may occasionally extend under the sterno-mastoid muscle to the side of the neck, where it opens, sometimes, though very rarely, it passes into the chest, and in other cases down into the axilla. When the disease is seated in the dorsal vertebrae, it usually passes forwards under the pillars of the diaphragm, down the side of the aorta and the iliac vessels, into the iliac fossa, and then presents through the anterior wall above Poupart's ligament; sometimes the pus sinks into the pelvis, and then passes out through the sacro-sciatic notch, giving rise to a large accumulation in the *gluteal* region. In other instances, again, the pus passes directly backwards, and large dorsal or lumbar abscesses are the result. In other cases, when the lower dorsal or upper lumbar vertebrae are diseased, the pus enters the sheath of the psoas muscle, thus constituting the common affection termed *Psoas Abscess*; and, passing along this, under

Psoas ligament, presents in the thigh; or it may continue its course downwards, burrowing under the muscles of this region, until it reaches the inguinal space, and may even pass from this some distance downwards on either calf or ankle. I have seen an abscess, which took its origin in disease of the dorsal vertebra, opened by the side of the tendo Achillis (Fig. 146). In other cases again, these abscesses take a different course; and, descending into the subperitoneal cellular tissue of the pelvis, may present by the side of the rectum in the perineum, or pass out of the sciatic notch, and down by the side of the trochanter. The quantity of pus contained in these collections is sometimes enormous, and abscesses of this description attain a greater magnitude than those of any other part of the body. In other cases the abscess may follow the course of both psoas muscles, and project on each groin at the same time.

Diagnosis.—The diagnosis of caries of the spine is made at the first sight of a patient affected by the disease, when once the angular deformity has taken place. It is, however, difficult before excoriation occurs, being only indicated at this period by the existence of pain in the back, and by some symptoms of spinal irritation. At this stage it may be mistaken for spinal or intercostal neuralgia, for rheumatism, or for chronic nephritis. The persistence, however, of a continuous fixed pain in the back should always lead to a suspicion as to the true nature of the disease, lest the grievous error be committed of treating as mere neuralgia or rheumatism what may turn out to be incurable disease of the spine itself. Here the tenderness on pressure, the increased sensibility to the application of heat, with a tendency, though it be very slight, to projection of some of the spines, the feeling of weakness in the back, the loss of its natural flexibility, and especially the occurrence of these symptoms in early childhood or youth, at a period when the other diseases rarely occur, would lead one to suspect the true nature of the affection.

The diagnosis of the connection between abscesses in the situations mentioned and those arising from diseased spine, is not always easy; as purulent collections of various kinds may form in the different planes of cellular tissue in the neighbourhood of the vertebral column, without any disease existing in it. Abscesses dependent on caries of the vertebra often attain a very considerable bulk before they present externally, which they usually do in the groin. Abscess in the groin may arise from the following causes.—1, from large lymphatic collections in the subcutaneous or intermuscular planes of cellular tissue; 2, from disease of the cellular tissue around the kidneys; 3, from pericecal abscess (on the right side only); 4, from iliac abscess, whether forming merely in the iliac fascia, or dependent on disease of the pelvic bones; 5, from hip joint disease, the abscess being pelvic; 6, from large buboes or glandular abscesses; 7, from an empyema perforating the pleura and finding its way down behind the diaphragm. The diagnosis of these various collections may, however, with a little caution, be readily made from the ordinary form of spinal abscess that descends along the psoas muscle. In the first place, in all these cases there is an absence of that dorsal pain and tenderness, with more or less excoriation, which, though not invariably present, is commonly met with in psoas abscess. Then again, if the collection be perinephritic, there would have been previous, or there are coexisting, symptoms of renal disease. If it occur in the cellular tissue around the cæcum, the pus will be peculiarly offensive, will present itself in a less distinct manner, and will probably be associated with symptoms of intestinal irritation. In those rare cases in which an empyema has found its way between the layers of the abdominal muscles, and presented in the groin, the stethoscopic signs will point

out the nature of the affection. In *abscess connected with disease of the hip-joint* there will be special evidences of the source of the pus. The only real difficulty consists in diagnosing large psoas abscess presenting in the thigh or in other parts of the lower extremity, and dependent on disease of the vertebral column, from *iliac abscess* taking its origin in the loose cellular tissue of the iliac fossa, whether it be connected or not with disease of the corresponding bone; and in these cases the difficulty is often not a little increased in consequence of the iliac abscess finding its way into the sheath of the psoas muscle.

In iliac abscess, the disease usually commences at or after the middle period of life, always in adults; and, as Stanley has observed, usually presents itself externally immediately above Poupart's ligament, being conducted forwards to this situation by the iliac fascia. Psoas abscess, on the contrary, most commonly occurs in the earlier periods of life; and extends down into the thigh along the course of the psoas muscle, so that it always presents below Poupart's ligament. It is also commonly associated with some indication of irritation of the muscle in the sheath of which it is situated; thus, there is an inability to stand upright, to extend the leg, and pain is complained of in walking. Psoas abscess also, in many cases, occurs suddenly, the patient finding on washing himself in the morning, that he has a large soft tumour in the upper part of the groin; whereas iliac abscess comes on more gradually, and presents in a more diffused and less circumscribed manner.

Iliac and psoas abscesses also require to be diagnosed from certain forms of *aneurism of the abdominal aorta or iliac arteries*; which, having become diffused by the rupture of their sac, have formed large non-pulsating extravasations in the sheath of the psoas in the iliac fossa. In such cases the previous history, the absence of distinct fluctuation, and possibly stethoscopic examination, together with the sudden appearance of the tumour, will throw light on the true nature of the case.

In other cases, again, when the abscess, after deeply burrowing, has perforated the fascia lata at one point, its feel closely resembles that of certain *fatty tumours*. Here, however, the possibility of emptying or diminishing the size of the swelling on pressure, and perhaps impulse on coughing, enable the surgeon to effect the diagnosis.

From *femoral hernia* the soft and fluctuating character of the swelling, its gradual return when pressure is taken off, and all absence of gurgling, constitute the chief distinguishing characters.

Prognosis.—The prognosis in caries of the spine is always bad. The deformity always continues more or less marked; and the patient, though he may eventually recover by ankylosis taking place, continues hump-backed in after-life. Very commonly the disease terminates in abscess and death. It was long ago remarked by Boyer, that the most fatal cases were generally those in which the spine preserved its straight position; whereas, when it was much curved, death seldom resulted. The truth of this remark I have had frequent occasion to verify; and the circumstance would appear to be owing to the fact that, when the spine continues straight at the same time that the bodies of the vertebrae are tuberculous and carious, ankylosis cannot occur, so that the spinal canal is opened and the cord irritated; whereas, when they have fallen together and very considerable gibbosity has resulted, ankylosis more readily takes place, and thus an imperfect cure is effected.

Treatment.—In infants, the utmost that can be done is to direct that they be laid prone upon a pillow or small couch constructed for the purpose, that

the general health be improved by tonics suited to their age: that they have the advantage of country or sea air; and that some counter-irritant, as the tincture of iodine, be applied by the side of the spine. In children that are somewhat older, and in adults, great advantage may be derived by strictly forbidding them to walk, stand, or sit erect; confining them rigidly to the prone couch, and adopting a general plan of tonic treatment. In fact, the principles of treatment are extremely simple: the improvement of the general health by good diet, tonics, and sea-air, in order to remove the morbid condition with which this disease is always associated. With regard to the value of active pyogenic counter-irritation, by means of issues or the actual cautery, much discrepancy of opinion exists. I cannot but think that these means are employed far too indiscriminately, and often in cases in which more harm than good results from their use. The rule for their employment appears to me to be this—that in the earliest stages of caries of the spine, and before the formation of abscess, they are of considerable service, possibly in arresting the progress of the disease in the osseous structures, and certainly in relieving pain and removing irritation of the cord and spinal nerves; but that, after abscess has formed, and is preventing either in the lower iliac fossa or in the thigh, they are not only useless in arresting mischief or inducing repair, but injurious by weakening, and being a source of additional irritation to, the patient. Rest in the horizontal position is the most important element in the treatment; if the patient be allowed to stand upright or to sit, the weight of the head and shoulders will tend to curve forward the weakened spine, and by their pressure increase the already existing irritation in it. The horizontal position relieves the diseased parts of this additional source of distress. In these cases the prone position is preferable to the supine, and the patient, if old enough, should always be laid upon a properly constructed prone couch. The prone position is certainly the best; for not only is the projecting angle formed by the excurvated spine not injuriously compressed, as it would be in the supine or lateral position, but the patient is more comfortable; and it is far easier to make the necessary application in the way of issues and moxas than could otherwise be done. At the same time, the back not being the lowest part of the body, there is a less tendency to congestion of the spinal veins, and to consequent increase of the inflammatory softening of the bones. When the disease has in this way been arrested, for which many months—at least twelve or eighteen—will be required, the patient may be allowed to get up and move about, by wearing proper apparatus so as to support the trunk. This may be constructed on the plan shown in the accompanying figure (Fig. 272). It combines three principles in its action—1, a broad pelvic band, making a firm basis of support round the lower part of the trunk; 2, lateral upright stems, terminating in crutches, by which the weight of the head and shoulders is taken off the diseased spine, and transmitted directly to the pelvic base; and 3, a posterior plate, which by means of a ratchet can be brought to bear directly upon the excurvated part of the spine, and support, and in some degree rectify, the position of this. It is of considerable importance in the treatment of this disease that

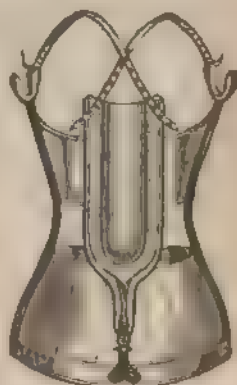


Fig. 272.—Apparatus for Supporting the Trunk in Vertebral Caries.

the patient should not be allowed to get or sit up too soon before the consolidation of the diseased vertebrae has taken place, otherwise he will to a certainty suffer a speedy relapse, and excruciation will greatly increase.

If debility of the lower limbs or paraplegia should come on, the administration of bichloride of mercury, in doses from the twentieth to the sixteenth of a grain, has been strongly recommended by Latham and Stanley. Issues will also be of use in relieving the nervous symptoms, though they may have had little effect on the disease of the bones.

When abscess has formed, the surgeon should be in no hurry to open it: but, in accordance with the principles laid down when treating of this affection, he should delay doing so, lest injurious fatal constitutional irritation be set up. When it becomes necessary, from the approach of the matter to the surface, to give exit to it, this should be done by valvular incision, closed, as soon as the pus has been discharged, by means of hare-lip pins, or in the way described on pp. 420—421.

The hectic or constitutional irritation that supervenes about this period, must of course be treated on general principles.

DISEASE OF THE ATLAS AND AXIS, AND OF THE ATLAS AND OCCIPUT, constitutes one of the most serious forms of vertebral caries. In these cases there are pain and swelling, with great difficulty or absolute inability in moving the head; after a time induration of the cellular tissue, with swelling and fluctuation behind the pharynx, come on, pushing forwards its posterior wall against the nasal apertures, causing the tongue to be extruded, occasioning much difficulty and distress in breathing, and giving rise to a peculiar nasal tone in the voice. The abscess may point here, or may extend outwardly under the muscles of the neck. Patients affected by this disease truly present a remarkable as well as distressing appearance. The sternomastoid muscles are remarkably tense and prominent, and, the neck being perfectly rigid, they are unable to turn the head, but when they want to look round have to twist their whole body; at the same time, the weakness in the neck usually compels them to support the head with both hands, putting one under the chin, the other under the occiput, and so holding it. The disease often terminates fatally by luxation of the vertebrae forwards, compression of the cord, and sudden asphyxia; or more slowly by hectic and gradual interference with the respiratory functions.

The *Treatment* must be conducted on precisely the same principles as that of angular curvature, by absolute rest, counter-irritation, and tonics. As great and immediate danger may result from the sudden displacement of the vertebrae, and the consequent compression of the cervical cord, the head usually requires to be steadied by proper machines calculated to support it and limit its movements.

CHAPTER LI.

DISEASE OF THE SACRO-ILIAC JOINT.

Disease of the *Sacro-Iliac Articulation* is a rare affection. With but few exceptions, systematic writers on surgery are altogether silent upon this subject. Boyer and Chelius mention the disease; but it is only by Nodden that any detailed description of it has been given. This may be partly

accounted for by the rarity of the affection, and partly, perhaps, by its having not unfrequently been confounded with some of the varieties of coxalgia or of spinal disease.

The sacro-iliac disease is essentially a very chronic affection, lasting for months and years. The disease appears to be strumous in its origin, partaking of the nature and ordinary character of "white swellings." I have never seen it in young children, and in all the cases which form the basis of these observations it has occurred in young adults from 14 to 30 years old. The exciting causes of the disease are obscure: I have not been able to trace it to blow or injury in any of the cases that have been under my care, although there can be very little doubt that such causes might excite it.

PATHOLOGY.—The disease may commence primarily either in the pelvic bones, or in the articular structures of the sacro-iliac junction. The annexed drawings (Figs. 273, 274), taken from a boy who died of tetanus from the irritation of an issue, six weeks after the commencement of disease in the sacro-iliac articulation, show the existence of erosion of the cartilages in patches, and clearly illustrate the existence of primary disease in those structures. The next drawing (Fig. 275), taken from a man about 30 years of age, who died of this affection after nearly two years of suffering, shows the disease in its most advanced stage. The bones, though bare and rough, are neither carious nor necrosed. They appear simply to be deprived of their incrusting cartilage and its investing synovial membrane. There is no deep erosion of them, no cavity, no sign of tuberculous infiltration; no evidence, in fact, of primary osseous disease. The ligamentous structures also of the articulations are only partially destroyed. The interosseous ligament was especially in a sound state; it had preserved to a great extent its firmness, and required to be divided with the scalpel in order to expose the interior of the joint and the opposed osseous surfaces. The structures that appear chiefly to have suffered are the synovial and cartilaginous elements of the joint. These are normally but imperfectly developed in the sacro-iliac articulation, and may, probably enough, readily undergo disorganising changes somewhat analogous to those which take place in the so-called "pulpy degeneration of the synovial membrane" in strumous joints.



Sacro-iliac Disease in its early Stage.

Fig. 273—Sacrum

Fig. 274—Ilium.



Fig. 275—Sacro-iliac Disease, more advanced

SYMPTOMS.—The symptoms characteristic of this affection arrange themselves in five distinct groups—viz., Pain, Swelling, Lameness, Alteration in the Shape of the Limb, and Abscess. These we must study separately.

1. *Pain.*—One of the earliest symptoms of this disease is a sensation of painful weakness at the lower part of the back and sacrum, increased by movements of the body in walking, stooping, or even in standing, giving the sensation as if the body were falling asunder. As the disease advances, the pain becomes more continuous, of a gnawing or rheumatic character. It is accompanied by a peculiar feeling of weakness, of falling asunder, or of want of support in the lower parts of the body. This pain is confined to the gluteal region and groin, and does not extend down the limb. When the patient is lying on his back or side, the limb on the affected side may be ab- or adducted, or the head of the thigh-bone may be pressed up against the acetabulum, without any increase of pain, provided the pelvis be fixed by the pressure of the hands. If this be not done, considerable pain will be experienced on moving the limb. So, also, if the surgeon seize the sides of the pelvis in his hands, and move them to and fro, or press them together transversely, pain will be elicited, the affected joint being then influenced by the movement communicated to it. There is tenderness on pressure about the gluteal region; but this is less about the hip-joint than in coxalgia, and gradually increases as the finger is pressed backwards upon the sacro-iliac articulation and sacrum.

2. *Swelling.*—A puffy intumescence is perceptible early in the disease, along the line of the affected articulation. It assumes a somewhat elongated appearance from above downwards, and does not extend to any distance outwards under the gluteal muscles, nor does it invade the natural hollow behind the trochanter. As the disease advances, and suppuration takes place, the swelling increases materially, and assumes different and peculiar characters, owing to the formation and diffusion of abscess.

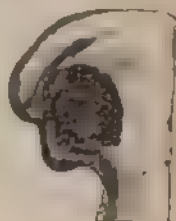
3. *Lameness* is an early symptom. The patient walks insecurely; has a feeling of want of proper support to the body; leans forward, and uses a stick. He puts the foot on the affected side to the ground, but does not tread upon it so firmly as upon the other. He cannot stand on the foot of the affected side, or twist himself suddenly round. As the disease advances, the powers of support and progression diminish, and at last the patient becomes unable to assume the erect position, lying in bed usually on the unaffected side.

4. *Alteration in the Shape of the Hip and Length of the Limb* are early and marked symptoms. From the very commencement of the disease, the limb on the affected side will be seen to be longer than the sound one; the tip of the inner malleolus being usually, as the patient lies on his back, half an inch below the level of the same point of bone on the opposite side. But, on close examination, it will be found that the measurement from the anterior superior spine to the inner malleolus gives equal results on both sides; hence the elongation cannot be owing to any change that has taken place in the bones or in the three large joints of the lower extremity, but must be dependent on some disturbing cause situated beyond the anterior superior spine of the ilium. On pushing our investigation more closely, we shall find that this point of bone is at a lower level, and at the same time more prominent, than its fellow on the opposite side, and that this displacement is produced, not by any obliquity of the pelvis consequent on a twist on the lumbar spine, as in hip-joint disease, but by the tilting forwards and rotation downwards of the whole side of the pelvis; for the displacement which takes place is a double one. The anterior superior spine is not only

accounted for by the rarity of the affection, and partly, perhaps, by its having not unfrequently been confounded with some of the varieties of osteitis or of spinal disease.

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Sacro-iliac Disease in its early stage.

Fig. 273—Sacrum.

Fig. 274—Ilium.

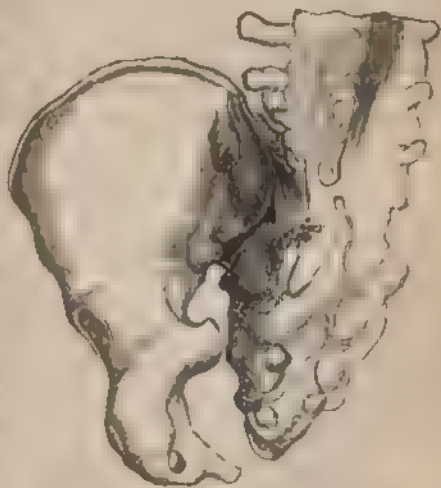


Fig. 275—Sacro-iliac Disease, more advanced.

3. From *spinal disease*, the diagnosis is usually sufficiently easy; for, although the situation of abscess resulting from caries of the vertebrae may in many cases be the same as that which is occupied by the collections of pus resulting from sacro-iliac disease, yet in caries of the spine, in the vast majority of instances, excavation of the vertebrae has become prominently marked by the time that the abscess has assumed so great a magnitude as to occupy the inferior lumbar or gluteal regions. In those rare cases in which, as in an instance that was some time ago under my care, caries of the vertebrae, with consecutive abscess, takes place without any angular curvature, it will be found that the patient complains of tenderness on the surgeon percussing the spine opposite the seat of disease; that the spinal column has lost its flexibility, moving stiffly and as a whole; that there is an absence of that elongation of the limb on the affected side, dependent on displacement of the wing of the pelvis, which is so early observable in sacro-iliac disease; and lastly, that examination of the sacro-iliac synchondrosis neither elicits pain nor reveals swelling or any of the other signs of disorganisation of that articulation.

4. *Coxalgia* is the affection that is most easily confounded with sacro-iliac disease, and that from which it is of most importance to make the diagnosis. It is especially from that variety of hip-disease which commences in the acetabulum, primarily involves the pelvic bones, and only secondarily implicates the joint, that it is difficult to distinguish sacro-iliac disease; and the importance of effecting this diagnosis is great when we reflect that these cases of hip-disease may now successfully be subjected to operative interference, whilst sacro-iliac disease does not admit of relief or removal by these means. The diagnosis between coxalgia in all its forms and the disease we are at present considering may be effected by attention to the following circumstances.

a. The seat of pain on pressure varies. In hip-disease the patient suffers most severely when pressure is exercised deeply behind and above the trochanter, in the hollow behind that osseous prominence, or when the compression is exercised against the anterior part of the hip-joint through the pectineus muscle. In sacro-iliac disease little or no pain on pressure is experienced in these situations; but tenderness is elicited by pressure upon the sacrum and along the line of junction between the sacrum and ilium, behind and altogether away from the hip.

b. The movements that occasion pain are different in the two diseases. In hip-disease, abduction and rotation outwards, or pressure of the head of the thigh-bone into the acetabulum, aggravate, to a greater or less degree, often to an unbearable extent, the sufferings of the patient. In sacro-iliac disease the thigh may be moved in all directions, ab- or adducted, rotated, flexed, or extended, whilst the patient is lying on the back, without any increase of suffering, provided the side of the pelvis be fixed by the surgeon. Should this precaution not be taken, the movement impressed on the thigh will be communicated to the diseased articulation, and will necessarily occasion suffering.

c. The signs connected with the alteration in the length of the limb differ in the two diseases. In hip-disease there may be, and usually is in the advanced stages, considerable shortening. This never occurs in sacro-iliac disease. In the earlier stages of coxalgia there may be, as there is throughout in sacro-iliac disease, elongation of the limb. But there is an important point connected with this. The elongation in hip-disease is always appreciable by measuring from the anterior superior spine of the ilium to the inner ankle. In sacro-iliac disease, however, the measurements between

at a lower level, but is also more prominent on the diseased than on the sound side. This is owing to the swelling of the affected articulation, not passing forwards, but rotating downwards, the anterior and superior portion of the ilium. The limb itself usually lies straight, is wasted, and inflexible.

5. Abscess occurs only at a late period of the disease. Many months, a year or more, may elapse before suppuration is fairly established, or, at all events before the formation of pus is so abundant and so circumscribed as to admit of recognition as an abscess. I have observed abscesses occur in connection with this disease in five situations—viz., over the articulation, in the gluteal and in the lumbar regions, within the pelvis, and in connection with the rectum.

The first indication of abscess is met with over the diseased articulation. The puffy swelling which is there perceptible in the earlier stages of the affection, gradually softens, until at last fluctuation is established in it. From this point it may spread outwards into the gluteal region, nearly as far as, but not enveloping the trochanter; or it may take another course, and stretch upwards, forming a considerable accumulation in the loin, upon and just above the crest of the ilium. These forms of sacro-iliac abscess are *extrapelvic*; the other varieties are *intrapelvic*. These latter are of three kinds. In one form the pus passes out of the sciatic notch, and thus gets under the gluteal muscles; in the other variety it gravitates downwards into the ischio-rectal fossa, and presents by the side of the rectum; and, in the third variety which I have observed, the abscess opens into this gut, abundant puriform discharge takes place *per anum*, and, flatus from the bowel passing into the suppurating cavity, a tympanitic abscess results.

Prognosis.—The prognosis of this disease is always most unfavourable. I am not prepared to say that it is of necessity fatal, but I have never seen a patient recover after the full development of the disease, and after suppuration had set in. I have, however, seen a case cured, in which, from the history of the symptoms, the thickening over the sacro-iliac articulations, and the permanent displacement of the side of the pelvis, there was every reason to believe that this disease had existed. But in this instance no abscess had formed.

Diagnosis.—The diagnosis of sacro-iliac disease is important, and not always easy. There are five distinct affections with which it may be confounded—viz., neuralgia of the hip, sciatica, spinal disease, coxalgia, and disease of the pelvic bones.

1. *Neuralgia of the hip* in young females may readily enough be confounded with the earlier stages of sacro-iliac disease. But the widely spread and superficial nature of the pain in the neuralgic affection, the coexistence of the hysterical temperament, the sex of the patient, and the absence of all limitation of morbid action to the neighbourhood of the diseased articulation, render the true nature of the affection sufficiently clear. The obliquity of the pelvis which occasionally occurs in neuralgia of the hip, and causes apparent elongation of the limb, is readily removed when the patient lies on her back; whereas, in sacro-iliac disease, position does not affect the displacement of the limb on the affected side.

2. *Sciatica.*—In this affection, the age of the patient, usually more advanced than that of the subjects of sacro-iliac disease; the seat of the pain, below the articulation, and its extent down the back of the limb; with the absence of elongation, will enable the surgeon to effect the diagnosis.

CHAPTER LII.

DISEASE OF THE HIP-JOINT.

HIP-DISEASE presents so many points of peculiar and serious importance that it is usually, and not improperly, considered as a distinct affection, apart from other joint-diseases. Like all these it may be of an acute, subacute, or chronic inflammatory character, most commonly occurring in strumous subjects; indeed, I think its connection with scrofula is generally more distinctly marked than that of most other affections of the joints. It almost invariably occurs before the age of puberty. Out of 48 cases of this disease, of which I have taken notes, I find that in 16 only did it take place at or after fifteen years of age, and, of these, in 6 cases only it happened above the age of twenty, thus it may be considered essentially a disease of childhood or early youth. It commonly comes on from very slight causes; over-exertion in a long walk, a sprain in jumping, a fall, or sitting in the wet, are usually the circumstances to which its occurrence is attributed.

FORMS OF THE DISEASE.—All the inflammatory affections attacking the coxo femoral articulation are usually confounded under the term "Hip-Disease" or "Coxalgia." This is too general an expression; and we shall find included under it several distinct forms of disease that differ from one another in pathology, symptoms, result, and treatment. On looking at the hip-joint in a surgical point of view, we find it to be composed of three distinct parts; viz., the soft structures, the acetabulum, and the head of the thigh-bone. Any one of these may be principally or primarily affected, and we may accordingly divide hip-joint disease into the three distinct forms of Arthritic, Acetabular, and Femoral.

This division is not a purely pathological one, but is of a practical character, especially in its bearing on the question of excision.

GENERAL PATHOLOGICAL CONDITIONS.—Before proceeding to describe each separate form of coxalgia in detail, we may consider briefly the six pathological conditions which are more or less common to each variety of the affection—viz., Pain, Attitude, Suppuration, Sinuses, Dislocation, and Anchylosis.

1. *Pain*.—The pain in the hip-joint disease varies greatly according to the form the affection assumes. In the more chronic forms of the disease it is at first slight, and, perhaps, rather referrible to the knee than to the hip; this is particularly the case in the femoral variety; and may be explained by the irritation of the articular branch of the obturator nerve. In the arthritic form it is always very acute, even intense, seated in the joint itself, and greatly increased by any movement, however slight, of the limb. In the acetabular form of the disease the pain is not at first referred to the joint, but rather to the iliac fossa or side of the pelvis; it afterwards becomes severe, gnawing, and deeply seated in the articulation. However slight the pain may be, it is always greatly increased by moving the limb, by pressing the surfaces of the articulation together, or by abduction. Hence the usual position of the patient with the foot raised and merely supported on the point of the toes, the knee and hip being flexed and adducted.

2. The *Attitude* of the limb is peculiar, and varies in different stages of the disease. In the early stage the limb is usually straight, carried slightly forwards, or perhaps somewhat abducted, owing to the irritation and con-

two points on the opposite sides of the body exactly correspond, the seat of the elongation being situated still higher up.

d. The alteration of the level and of the prominence of the two anterior superior spines, in sacro-iliac disease, may be confounded with that arising from the obliquity of the pelvis usually occurring in the early stages of coxalgia. But here also the diagnosis may be effected by observing that the displacement of the bone in sacro-iliac disease is permanent, and is not influenced by position. The obliquity of the pelvis in hip-disease, giving rise to apparent elongation of the limb, is dependent on a twist in the lumbar spine, which may be rectified by placing the patient on his back, and making a little manipulation. The alteration in the level of the two ilia, in sacro-iliac disease, is not modified by change of position, or by any movement that may be impressed upon the spine.

5. *Disease of the pelvic bones* may of course occur independently of any affection of the sacro-iliac articulation; and, when so occurring, it always commences at a distance from the joint—the crest of the ilium, the tuberosity of the ischium, or the acetabulum being the usual seats of the disease. When it occurs in the first of these two situations, the resulting abscess seldom attains a very large size, and is altogether above or below the synchondrosis, the outline of which can be felt clear and unobscured by swelling of any kind. When the abscesses are opened, the sinuses that result will lead directly down to the rough and carious bone, examination of which will leave no doubt as to the nature of the cases. In these cases, also, no change takes place in the length of the limb, or in the position of the side of the ilium.

When the acetabulum is primarily affected, the difficulty of diagnosis may be greater, in consequence of the large size and often intrapelvic nature of the abscesses, and the co-existence of a certain amount of displacement or elongation of the limb. But here the same circumstances that enable the surgeon to effect a diagnosis in ordinary coxalgia—viz, the pain in movement influencing the hip-joint merely, and the increased length of limb, as determined on measuring from the anterior superior spines—will prevent his falling into error as to the true nature of this disease.

TREATMENT.—With respect to treatment I have but little to say, and that by no means of a satisfactory character. The treatment must be conducted on the same general principles that guide us in the management of cases of carious diseases of the spine. Long-continued rest in the prone position; fixing the pelvis and hip-joint by means of a large leather cap; counter-irritation, in the earlier stages, before suppuration has set in (after that has occurred it is worse than useless); opening abscesses, when large and chronic, by valvular incision; and keeping up the powers of the patient by ordinary dietetic means and medicinal tonics, are the means that must be employed, with the view of procuring anchylosis; but usually, unfortunately, with little advantage beyond the mitigation of suffering and the prolongation of life for a limited time. When once suppuration has set in, our hopes of a cure are materially lessened. I am not prepared to state that the affection is inevitably fatal when it has reached this stage, but certainly in the very great majority of instances it is so; the profuse discharge from the large abscesses connected with it inducing hectic, and exhausting the powers of life. No operative interference is admissible in sacro-iliac disease.

acetabulum. When it appears *above* the ligament, it probably leads to intra-pelvic abscess. On the other hand, when the abscess opens *below* Poupart's ligament, there is generally disease of the rami of the pubes or ischium.

The situation of the sinuses, as well as their direction, will thus be found to be of the greatest value in leading the surgeon to a more accurate diagnosis of the seat and extent of the osseous disease than he could otherwise form. And, indeed, it is only by attention to these circumstances that he is enabled in many cases to form an approximate opinion on these points; for the diseased bone is often so covered in by healthy osseous structure, and by plastic matter, that the probe cannot touch it; or the sinus may be so tortuous that a straight probe cannot follow its sinuities.

But there is other important information obtainable from an attentive consideration of the situation of the sinuses. It is with reference to the probable nature of the osseous disease. In *femoral* coxalgia, this is almost invariably caries—sometimes simple, in other cases of a tuberculous character: hence those sinuses that indicate the existence of primary disease of the upper epiphysis of the thigh-bone prove this to be of a carious nature; whilst, on the other hand, sinuses occurring in the pubic region and by Poupart's ligament are almost invariably dependent on the presence of necrosed bone—necrosis being the form of disease that affects the acetabulum and pelvic bones.

5. *Dislocation*.—In the advanced forms of hip-disease, dislocation of the head of the thigh-bone commonly occurs, and may arise from three causes—
a. The destruction of the joint; the capsular ligament having given way in consequence of inflammatory softening and ulceration, and the head of the bone being thrown out of the cavity by the action of the surrounding muscles.
b. Caries and partial absorption of the head of the thigh-bone may have taken place, so that it no longer fills up the cotyloid cavity; and, the ligaments being at the same time destroyed, it slips out on to the dorsum ili.
c. A fungous fibro-plastic mass may sprout up from the bottom of the cavity, and thus tend to push the bone out of it; and, after it has been so extruded, this growth will completely fill the acetabulum.

The occurrence of dislocation is, in the great majority of cases, preceded by the formation of abscess in and around the joint; but in some instances it happens in consequence apparently of the softening of the ligaments, the head of the bone being thrown out of the acetabulum without the supervention of abscess or any sign of suppuration. In these cases, a false joint may be formed upon the dorsum ili, where the head of the bone lodges. When it is lying in a suppurating cavity it will always be found to be in a carious state, and then no attempt, or at least an imperfect one, is made at the construction of an articulation around it.

Dislocation takes place chiefly in the *femoral* variety of the disease, in which the head of the thigh-bone is more or less destroyed, and the acetabulum is filled with fibro-plastic deposit, which is material of a reparative character, developed in those cases in which the lining cartilaginous surface of the joint has been removed, leaving roughened bone, which thus becomes covered. The formation of this material is interesting, as showing the possibility of repair in the acetabulum when it is only secondarily affected. In the *acetabular* form, the position of the head of the bone is more uncertain. In some cases it is dislocated upon the dorsum ili; in other instances, the head of the bone is not thrown out of the cotyloid cavity; but this, being carious, and becoming at last perforated, may allow the upper end of the thigh bone to slip into the pelvic cavity.

6. *Anchylons* may occur either with or without previous suppuration. If

the joint has suppurated and the head of the bone is thrown on the dorsum ili, a false joint may eventually form, or osseous ankylosis in a more or less faulty position take place. If the head of the bone continue in the acetabulum without suppuration, osseous ankylosis (Fig. 248) may ensue with but little shortening of the limb.

ARTHRITIC COXALGIA.—The arthritic form of hip-joint disease may commence in any of the soft structures of the joint; in the capsule, the synovial membrane, the cartilages, or the round ligament. These are alone primarily affected, usually with acute inflammation presenting the characters of arthritis in other joints, and the disease generally continues limited to these structures throughout. Aston Key believed that the round ligament was very frequently the starting-point of inflammation of the hip-joint, and other surgeons have referred its origin to each of the other structures mentioned. Without denying the possibility of disease sometimes commencing in the ligaments, illustrative of which we have a beautiful model in the Museum of University College, I believe that it more frequently appears first in the cartilage incrusting the head of the thigh-bone; for, though it is extremely difficult to prove this, opportunities of dissecting this form of hip-disease in its early stages being very rare, yet the symptoms that attend it so closely resemble those accompanying the diseases of the articular cartilage in other joints, that it is difficult not to infer that this may be the case in the hip.

Symptoms.—In this form of the disease the patient is seized with signs of acute inflammation of the joint, coming on rather rapidly, and with great constitutional disturbance and pyrexia. The pain in the joint in these cases is of the most excruciating character, accompanied by spasms and twitchings of the limb, and marked by nocturnal exacerbations. The suffering is so intense, that the patient cannot bear the slightest movement of the limb; a sit of coughing, the weight of the bed-clothes, or the shaking of the bed by a person leaning against it, will give rise to the most intense agony; and in the intervals of his suffering the patient is in constant fear of a return of the pain, to which he looks forward with much anxiety. In these cases the limb is everted, abducted, perfectly helpless, and motionless; the nates will be found flattened, and there is usually some fulness about the anterior part of the joint, under the pectineus muscle, or to its outer side, above the trochanter. There is also sometimes true elongation of it, in consequence of the capsule becoming distended with fluid, and pushing the head of the bone downwards. On measuring the limb, in order to ascertain its true length, it is necessary to examine the two together, and to place the sound in exactly the same position as the diseased one; unless this be done, error will very probably creep in, for, on measuring the lower extremity from the anterior superior iliac spine to the lower border of the patella or the inner ankle, it will be found to be of greater length when adducted or extended than when abducted or bent.

In some cases the distension of the capsule with synovial fluid, as the result of the inflammation in the joint, may be so great as to lead to its rupture, and to the sudden dislocation of the head of the bone on to the dorsum ili, with great pain and much shortening; this, however, is of very rare occurrence, the dislocation seldom taking place until after abscess has formed within the joint, and the articulation has been thus destroyed.

Results.—In this, the acute form of hip-disease, various terminations may take place; the result depending greatly upon the constitution of the patient, and on the manner in which the affection is treated. Under the most favourable circumstances, as the inflammatory action is subdued, the disease falls into

the subacute condition, and recovery gradually but very slowly takes place, with a limb that continues somewhat stiff and partially ankylosed, as well as wasted and somewhat shortened from disuse. Sometimes, complete ankylosis occurs without the previous formation of abscess. In other, and the majority of instances, abscess forms, and then the patient may either be worn out by the continued irritation of diseased bone, or by the profuseness of the discharge; or, great shortening taking place either by the absorption of the head of the bone, or its dislocation out of the acetabulum, the cavity of the abscess may ultimately contract, the carious portions of bone exfoliate, and the sinuses close after years of suffering. Under the most favourable circumstances, when once the joint has been acutely inflamed, a year or two will elapse before the patient can use his limb with any degree of security. The safety of the patient depends in a great measure on preventing the occurrence of suppuration. If the constitution be very strumous this can rarely be done; but, if it be tolerably healthy, the disease may be prevented from passing on to this stage, and then the patient may recover with an useful, though somewhat stiff and crippled limb. If suppuration occur, it is very seldom that an adult patient recovers, hectic and exhaustion speedily carrying him off. The life of children may, however, be saved even under these circumstances; but they will be left permanently lamed.

ACETABULAR COXALGIA.—In the acetabular form, the disease originates in the pelvic bones, and the articulation and head of the thigh-bone are only secondarily involved. The disease of the pelvic bones has more of the character of necrosis than of caries; but the two morbid conditions are in many cases compound, the acetabulum being carious, whilst the rami of the pubes and ischium are necrosed. The soft articular structures speedily become disorganised; the cartilage incrusting the head of the thigh-bone is absorbed, the femoral head itself becomes eroded rather than carious; but the disease does not extend into the neck or trochanters.

This form of hip-joint disease is more common in adults than any other variety.

The *Symptoms* are usually obscure in the early stages, but become very unequivocal as the disease advances. There is pain around the hip rather than in the joint itself; this, however, becomes tender on pressure, and the patient cannot bear on the limb, but no alteration takes place in its length, although it becomes greatly wasted. Abscess invariably forms, perhaps at first within the pelvic cavity; but it soon presents externally. Sometimes it passes down by the side of the rectum, or through the sciatic notch to the gluteal region; but generally it points near the pubes, under Poupart's ligament. Hectic comes on; the sufferings are greatly increased; and death from exhaustion speedily ensues in this, which is by far the most fatal form of hip-disease. In cases of this form, dislocation, though it is met with now and then, rarely takes place. Sometimes, however, the destruction of the acetabulum is so extensive that the head of the thigh-bone penetrates it, and passes into the pelvic cavity. Dislocation is most frequent when the disease has destroyed the head of the bone; so that, the head being no longer present, no impediment is offered to the action of the muscles around the joint, and the bone at length slips from its position in the cavity of the acetabulum.

FEMORAL COXALGIA.—In the femoral form of coxalgia, the morbid action commences in the upper epiphysis of the thigh-bone. The progress of this variety of coxalgia is very insidious; its symptoms are by no means prominent; it generally occurs in young children, and is usually, I believe, of

tubercular origin. In it the yellow, somewhat soft, friable matter fills up the cancelli of the head and neck of the thigh-bone, resembling, and indeed being identical with, tubercular deposit in other organs. This form of coxalgia is accompanied inevitably by the formation of abscess in the soft parts around the joint, commonly on the outside of the thigh, and in the gluteal region, the articular surfaces are eventually destroyed, and the head of the bone becomes carious and is displaced, leading to shortening and distortion of the limb; the disease very generally terminates in death from exhaustion and hectic.

Symptoms.—The disease usually commences in a very insidious manner. It assumes a subacute character, and is chiefly met with in young children. The first symptom that usually attracts attention is, that the child limps and walks in a peculiar shuffling, hopping manner; he does not stand firmly upon both feet, but rests on the toes of the affected one, the knee of which is bent. On examining the condition of the limb it will be seen to be everted, somewhat abducted, slightly flexed upon the thigh, with the knee partly bent, and apparently shorter than the other. This shortening, however, is apparent and not real; for on laying the child on its back, it will be found that the pelvis is placed obliquely, the anterior superior spine on the affected side being raised to a higher level than that on the sound one, and at the same time turned somewhat forwards. Measurement of the limb from this point to the ankle will show that there is no alteration in its length. The obliquity of the pelvis, which is of very early occurrence in diseased hip, is owing to the child lifting the foot off the ground in order to avoid pressure on it in walking or running; and in doing this he is obliged to raise, not only the limb, but the corresponding side of the pelvis. This apparent shortening will commonly give place, after keeping the child in bed for a few days, to a simulated elongation of the limb; the pelvis on the affected side descending below its natural level. At the same time that these symptoms are noticed, the child usually complains of pain in the hip, especially on pressing over the pectineus muscle, or behind the trochanter; this is increased by standing, walking, or any attempt to bear upon the joint; abduction also, and rotation of the limb outwards, are particularly painful, and any concussion of it, as by striking the heel or knee, will greatly increase the suffering. At this stage of the disease, the patient will often refer to the knee rather than the hip as the seat of pain, and a careless surgeon might be misled and treat the wrong joint; the more so, as there is not unfrequently a good deal of cutaneous sensibility about the inner side of the knee-joint. This pain appears to be seated in the obturator nerve; the articular branch of which sent to the hip joint, becoming implicated in the disease, communicates a radiating pain that is felt at the extremity of the long descending branch which is distributed to the knee. On turning the child upon its face it will be observed that the nates are somewhat flattened, the fold being in a great measure obliterated; and, if it be a female, the vulva on the affected side will be seen to be placed at a lower level than on the sound one.

As the disease advances, abscesses may form at any part in the vicinity of the joint. They most commonly occur under the glutei muscles; but sometimes at the anterior part, under the pectineus muscles. When in this situation, they occasionally give rise to very severe suffering down the inner side of the thigh by exercising pressure upon the obturator nerve, which may sometimes become tightly stretched over the subjacent cyst of the abscess. It is about this period that true shortening of the limb takes place, which at the same time becomes abducted and inverted, thus assuming a very dif-

ferent position from that which it presented in the early stage of the disease. The different positions into which the limb falls in the two stages of the complaint are evidently due to alterations in the muscular action brought to bear upon it. In the early stage, the strong external rotators, which are in close relation with the joint, become irritated by the extension of inflammatory action to them, or by the pressure to which they are exposed by the distended capsule; and hence, these being called into increased action, the limb is everted, at the same time that it is slightly flexed and abducted by the irritation to which the psoas and iliacus are subjected. As the disease advances, these muscles become wasted, undergo fatty degeneration, absorption, or disintegration, by the formation of abscesses underneath and around them; hence, the action of the adductor muscles being no longer counter-

balanced, the limb is drawn upwards and forwards, and turned inwards (Fig. 276).

The shortening of the limb may arise, in very chronic cases, from general atrophy of the member, consequent upon disuse; and this, no doubt, in all instances after a time influences its condition. Most commonly, however, shortening occurs from absorption of the head of the bone, which is usually at the same time dislocated upon the dorsum of the ilium. In these cases, the remains of the dislocated head can be felt through the thin and weakened muscles in its new situation, and in other in-



Fig. 277.—Carious Head of Thighbone after Excision

Fig. 276.—Chronic Disease of Hip-joint.

stances may be found lying at the bottom of a cavity in a carious state (Fig. 277).

PROGNOSIS OF HIP-JOINT DISEASE.—The prognosis in cases of diseased hip must be regarded from two points of view—1, as concerns the *life of the patient*; 2, as to the *utility of the limb* that will be left.

1. *Life.*—Disease of the hip-joint, and of the contiguous osseous structures, is dangerous to life in proportion to the abundance and the long continuance of the suppuration; and this is dependent partly on the patient's constitution, but chiefly, and in the first degree, on the extent and nature of the osseous disease. In the *arthritic* form of coxalgia, suppuration is often prevented by rest and appropriate treatment; and when this is the case, the patient will usually recover. If suppuration take place in cases of this kind, recovery need not be despaired of; but convalescence will be greatly protracted. In such cases much will depend on the patient's constitution. If that be highly scrofulous, tubercularization in other organs, more particularly in the lungs or spine, may very probably take place, and destroy life.

When the bones that enter into the composition of and that surround the hip-joint are diseased, the case at once assumes a much graver aspect. Some surgeons are of opinion that if caries exist the patient must die. In this doctrine I cannot concur. I believe that much will depend on the situation and extent of the caries, and on the question whether it be primary and tuberculous, or secondary to disease of the soft joint-structures. In the latter case the head of the bone, denuded of its incrusting cartilage, softened and carious upon the surface, may be thrown on to the dorsum ilii; profuse and long-continued suppuration will ensue, yet, under good and careful management, and without operation, I have in some instances seen recovery take place.

In those cases in which the disease is primarily *femoral*, and dependent upon tuberculosis of the head of the thigh-bone, the prognosis, if the case be not subjected to operation, is very unfavourable. Here we have a form of caries in which there is no prospect of spontaneous cure; and the patient will be worn out by hectic, induced by the long-continued and irremediable suppuration resulting from the irritation excited by the dislocated and carious femoral head in the gluteal region.

The condition of the *pelvic bones* is one that more materially than any one other circumstance influences the prognosis in cases of coxalgia. When the acetabulum alone of these bones is affected, the prognosis will turn upon whether this acetabular disease be primary or secondary. If it be *primary*, intrapelvic abscess will probably form, pointing above Poupart's ligament; and whether the head of the thigh-bone be dislocated or not, I believe that death must necessarily ensue, unless the diseased osseous structures be excised. If it be *secondary* to disease of the head of the thigh-bone, in which the primary mischief has developed, the condition of the acetabulum need not seriously affect the prognosis. In these cases the head of the bone becomes dislocated, and this very displacement is the first step towards the cure of the disease in the acetabulum. The surface of this cavity, which is roughened, and deprived of its incrusting cartilage, speedily becomes covered by plastic exudation. This undergoes fibroid transformation; and in the course of a short time the whole cavity becomes filled up by a dense elastic fibroid growth, which is in fact the medium of repair of the diseased and disused acetabular cavity.

When the morbid action extends to the osseous structures around the acetabulum, such as the rami of the ischium and pubes, the body and the tuberosity of the ischium and the upper lip of the acetabulum, and even the dorsum of the ilium, the disease usually partakes more of the nature of necrosis than of caries, and is perfectly incurable, except by operation. In such extensive pelvic disease as this, natural means are quite unable to effect a cure, and the patient must die of hectic or intercurrent disease, unless recourse be had to excision of the head of the thigh-bone and the whole of the necrosed and carious osseous structures.

2. *Utility of the Limb.*—This will depend chiefly upon the form of the disease, and to some extent upon the treatment adopted. When the coxalgia is *arthritic*, and suppuration has not taken place, ankylosis of a more or less complete form will usually ensue; and if the thigh have been kept in the straight position, a sufficiently useful limb will be left, but slightly shortened, and possessing free compensating movement in the lumbar spine, enabling the patient to swing it with facility as he walks.

If suppuration have taken place, and the head of the bone have been absorbed or dislocated, the limb, even under the most judicious treatment, will be left considerably shortened, weakened, wasted, and more or less

adducted, with the knee carried somewhat forwards, as well as inwards, and the patient walking often most imperfectly and with great difficulty on the points of his toes.

DIAGNOSIS.—In making the diagnosis of coxalgia, care must be taken not to confound it in its early stages with an ordinary attack of *rheumatism*, a mistake that not unfrequently happens. The alteration in the shape and position of the limb, the obliteration of the fold of the nates, and the limitation of the pain to one joint, will usually prevent the surgeon from falling into this error. With *disease of the knee*, care must be taken not to confound hip-disease, in consequence of the pain in the early stages being commonly referred to that joint; here the absence of any positive sign of disease about the knee, and the existence of all the signs of disease in the hip that have already been noticed, will enable the surgeon to diagnose the true seat of the affection. *Lateral curvature of the spine*, accompanied by neuralgic tenderness in the hip, occasionally gives rise to apparent shortening of the limb with pain and rigidity; but in these cases the existence of the spinal affection, the superficial nature of the pain, and the absence of increase of suffering when the joint is firmly compressed, or of painful startings at night, will indicate the true nature of the affection. *Abscess* may occasionally, though rarely, form in the vicinity of the hip without that joint being diseased. Should this take place towards the anterior aspect of the articulation under the pectineus muscle, it may, by its pressure upon the obturator nerve, occasion pain in the thigh and knee, as in those cases in which the articulation is affected; here, however, the sound state of the joint at its posterior and outer part, the absence of all obliquity of the pelvis, and of the other signs of the true hip-disease, will enable the diagnosis to be effected. The diagnosis from *sacro-iliac disease* has been described at p. 796.

TREATMENT.—The treatment of disease of the hip must be conducted with reference to the form of the disease, the acuteness of the attack, and the severity of the local and constitutional symptoms. In all cases this affection must be managed in accordance with those general principles that guide us in the treatment of inflamed joints.

It is of especial importance to adopt early measures. If we wish to prevent the occurrence of suppuration, dislocation, or ankylosis, the child must, on the supervention of the earliest symptoms of impending mischief about the joint, be put under proper constitutional treatment, and complete rest of the limb must be secured by a well-fitting leather splint. By early attention, a cure may be effected; whereas, if the case be neglected in its earlier stages, the utmost the surgeon can do is to save the life of the patient; the limb invariably falling into a shortened, withered, and distorted condition.

When the disease is of the acute *Arthritic* kind, the patient must of course be kept in bed, and absolutely at rest, and be treated with calomel and opium, freely administered, having a full dose of opiate at night, in order to prevent the painful startings of the limb. The inflamed joint should be leeches, or, if the patient can bear it, cupping-glasses may be applied near the trochanter; it must also be comfortably arranged upon pillows, so as to be kept in as easy a position as possible; and great relief will be afforded to the patient by the application of hot poppy-fomentations. When the inflammatory action has been somewhat subdued, the joint may be conveniently fixed by means of a leather splint or the starched bandage. Of the two, I prefer the starched bandage, as being more easily applied, and forming a better fitting and more secure casing to the limb. In applying it, the limb should be bandaged from the toes upwards, and well padded

When the bones that enter into the composition of and that surround the hip-joint are diseased, the case at once assumes a much graver aspect. Some surgeons are of opinion that if caries exist the patient must die. In this doctrine I cannot concur. I believe that much will depend on the situation and extent of the caries, and on the question whether it be primary and tuberculous, or secondary to disease of the soft joint-structures. In the latter case the head of the bone, denuded of its incrusting cartilage, softened and carious upon the surface, may be thrown on to the dorsum of the ilium, profuse and long-continued suppuration will ensue, yet, under good and careful management, and without operation, I have in some instances seen recovery take place.

In those cases in which the disease is primarily *femoral*, and dependent upon tuberculousness of the head of the thigh-bone, the prognosis, if the case be not subjected to operation, is very unfavourable. Here we have a form of caries in which there is no prospect of spontaneous cure; and the patient will be worn out by hectic, induced by the long-continued and irremediable suppuration resulting from the irritation excited by the dislocated and carious femoral head in the gluteal region.

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2. *Utility of the Limb.*—This will depend chiefly upon the form of the disease, and to some extent upon the treatment adopted. When the coxalgia is *arthritic*, and suppuration has not taken place, ankylosis of a more or less complete form will usually ensue; and if the thigh have been kept in the straight position, a sufficiently useful limb will be left, but slightly shortened, and possessing free compensating movement in the lumbar spine, enabling the patient to swing it with facility as he walks.

If suppuration have taken place, and the head of the bone have been absorbed or dislocated, the limb, even under the most judicious treatment, will be left considerably shortened, weakened, wasted, and more or less

being perhaps adducted and inverted so far as to be twisted over the other, or drawn up upon the abdomen, much may be done to lessen the deformity by putting the patient under chloroform, bringing down the limb, and fixing it in a starched bandage. Ankylosis in a good position may thus be sometimes obtained, and the patient's condition be greatly improved. It is a question whether an attempt at reduction should be made in these cases of consecutive dislocation, as it is very rarely that it would prove permanently successful, the acetabulum being either filled up with fibrous matter, or the head of the bone so diseased and lessened in size, that it would not remain in its cavity when put back. Occasionally, however, reduction may be successfully effected. In a woman under my care at the Hospital, with spontaneous dislocation of the hip of about a month's duration, reduction was effected by means of the pulleys, and the head of the bone replaced in the cotyloid cavity, where it remained for some weeks; becoming, however, displaced again in consequence of its being necessary to remove a bandage that was applied, as she became affected with inflammation of the chest, and could not bear its pressure. If ankylosis be likely to occur, the surgeon must endeavour to secure it with the limb in a straight position. After a stiff joint has formed, the mobility of the lumbar vertebræ, and more particularly of the lumbo-sacral articulation, will be found to be greatly increased; so that at last the patient will walk with little inconvenience, rotating the pelvis on them. If the ankylosis be not osseous, but the result of the *Arthritic* form of the disease, and especially if the head of the bone be still in the acetabulum, the limb may be straightened by forcible extension and rotation under chloroform, and the heel thus brought to the ground.

EXCISION OF THE HEAD OF THE THIGH-BONE AND OF THE HIP-JOINT.—White of Manchester, in 1769, was the first to propose, and Anthony White, of the Westminster Hospital, in 1821, was the first to perform, this operation. This he did on a boy about eight years of age, who had suffered from disease of the hip-joint for three or four years, and in whom the carious head of the thigh-bone rested on the *dorsum ilii*. Mr. White removed the head and trochanters of the bone, and the patient recovered from the operation, dying of phthisis five years afterwards. The preparation is in the Museum of the College of Surgeons. This operation was repeated by Hewson of Dublin, in 1823; and then seems to have been forgotten in Great Britain until its revival, in 1845, by Fergusson. But in the meanwhile it had not entirely escaped the attention of continental surgeons. Oppenheim, in 1829, and Seutin, in 1832, excised the head of the femur for gun shot injury; and in 1842, Textor published an essay on this subject. Since the operation was revived by Fergusson, in 1845, it has been frequently performed, certainly more than a hundred times, and may now be looked upon, notwithstanding the violence with which it has been assailed in some quarters, as being an established surgical procedure in appropriate cases.

Cases requiring Operation.—Diseases of and about the hip-joint may, so far as the question of operation is concerned, be divided into two great classes—those in which no suppuration takes place, however acute the inflammation may have been; and those in which abscess forms.

To the first class belongs the *Arthritic* variety of the disease. In this form of coxalgia, the patient commonly recovers with a stiffened or even completely ankylosed, though useful and straight limb, dislocation of the head of the bone not having occurred. In such cases, I believe that excision is never needed; at least, I have never had occasion to do it, nor have I ever seen a case that seemed to me to justify such a procedure.

The second class of cases—those in which abscess forms—are by far the most numerous. In the great majority of these, however, the head of the bone is the part chiefly affected, and in these recovery will take place eventually, under properly conducted medico-surgical treatment. But the recovery in such cases is always so far incomplete that the limb is left much crippled, and often of but little utility. In cases of this kind, after years of suffering and of confinement to bed, and after a hard struggle for existence, we find the unfortunate patient left eventually with a limb that is shortened to the extent of from two to four inches, wasted and adducted, with a projecting deformed hip seamed with cicatrices; the remains of the upper epiphysis of the thigh-bone being dislocated from the acetabulum, and adherent to the dorsum ilii by firm ankylosis. The limb is unable to support the body, and cannot be extended, nor can the sole of the foot be firmly planted on the ground; but the leg is to a certain extent useful in progression, the patient using it as a kind of paddle to push himself on with, as he limps on the point of the toes. In these cases, it is interesting to observe how nature compensates for the loss of all abduction and rotatory power in the hip by giving an extremely increased degree of mobility to the lumbar vertebrae; so that the patient, in walking, swings the pelvis from these, and thus in a great degree makes up for the loss of the natural movements in the coxo-femoral articulation.

But, though recovery takes place eventually in the great majority of cases of coxalgia that have even advanced to suppuration, yet in some, and not a few instances, the patient's constitution becomes unequal to the drain imposed upon it, and fatal hectic will eventually supervene. This fatal result is the direct consequence of the wasting and exhausting influence of the long-continued discharge of pus from masses of carious or necrosed bone, too extensive or too deeply seated to be eliminated by the natural actions of the part. It is in such cases as these that conservative surgery steps in, and endeavours to save the patient's life by the removal of the morbid cause that keeps up the discharge which is wasting it away. The object here is simply to save life by the removal of diseased bone. For the same reason—the preservation of life from hectic—that the surgeon amputates in an extreme case of suppurating disorganisation of the knee-joint, he excises in an extreme case of disorganisation of the osseous structures that enter into the formation of the hip-joint: amputation is here too formidable a proceeding to be undertaken, and yet the removal of the diseased bone, the irritation and suppuration from which is rapidly destroying the patient, is an imperative necessity. And here it is impossible not to be struck with the strange inconsistency of those surgeons who, looking upon caries of the bones entering into the conformation of the hip-joint as necessarily fatal, yet condemn as improper the only means of saving the patient's life—viz., the excision of the diseased osseous structures—and blame others for performing an operation which has saved the lives of numerous patients affected by a disease which they themselves have declared to be incurable.

The *Femoral coxalgia* is that form of the disease that is most amenable to operation. In severe and extreme cases of this variety of hip-joint disease, the upper epiphysis of the thigh-bone will be found lying in a state of caries on the dorsum ilii, in a suppurating cavity, with sinuses leading down to it. The pelvic bones are sound; the acetabulum is filled by fibro-plastic matter of a reparative character, though possibly it may be slightly roughened and necrosed at one lip. The soft structures in the gluteal region are thinned and wasted; the limb is incurably shortened, atrophied, and adducted. In such cases as these, the patient will probably perish, if left to the unaided

efforts of nature ; or if he recover, after years of suffering, it will be with a limb shortened, deformed, and but little useful. Resection, being limited to the upper end of the thigh-bone, or at most to the roughened lip of the acetabulum as well, is an easy operation, removes the cause of the wasting discharges and hectic, and in no way increases the already existing shortening, as it is limited to that portion of diseased bone which is already lying above and behind the acetabulum, and which is affected by incurable caries of too extensive and deep-seated a character to disintegrate and crumble away in the discharges, so that a natural cure without operation could take place.

In the *Acetabular Pelvic* form of coxalgia, the ultimate result is, I believe, inevitably fatal, if the disease be allowed to run its own course unchecked by operation. Large portions of the pelvic bones in and around the acetabulum—such as the ischium, the tuber and ramus of the ischium, the ramus of the pubes and the dorsum ili—fall into a state of necrosis ; that cavity becomes perforated (Fig. 278) ; and the head of the thigh-bone, still lying in



Fig. 278.—Perforation of the Pelvic Bones in Acetabular Coxalgia.

it, becomes denuded of its cartilaginous investment, roughened, and carious, as is well seen in the annexed drawing (Fig. 279), taken from a patient of mine who died of this form of the disease ; or it may be dislocated in a carious state on to the dorsum ili. Large abscesses, intra- as well as extra-pelvic, form, and the patient dies worn out by hectic ; the natural efforts of the part being entirely unavailing to separate and to eliminate such large necrosed masses, deeply lying, and covered in by the upper end of the thigh-bone.



Fig. 279.—Carious Head of Thigh bone in Acetabular Coxalgia.

Removal of Diseased Acetabulum and Pelvic Bones.—Until a very recent period, surgeons feared to undertake the removal of large carious and necrosed portions of the pelvic bones, and acetabular disease of the hip-joint was accordingly allowed to run its fatal course unchecked. Mr. Hancock was the first surgeon who undertook the removal of large portions of these bones, and since then the operation has been done several times by others. In no case has, I believe, more extensive disease been removed with a good result than in a girl who was sent to me some years ago by my friend Mr. Tweed, and from whom I removed the upper end of the thigh-bone, the acetabulum, the rami of the pubes and of the ischium, a portion of the tuber ischii, and part of the dorsum ili. This patient, when admitted into the hospital, was in the last stage of disease, exhausted by the constant discharge, and must inevitably have speedily sunk under the effects of the disease, had no effort been made to remove the cause of the prostration. At the operation, she was so exhausted that it was necessary to leave her on the operating-table for some hours before she was sufficiently restored

to bear moving into bed. Nevertheless, by the free use of stimulants and nourishing food, she recovered rapidly; and when I saw her, nearly three years afterwards, the limb presented the appearance in this drawing (Fig. 280); it was straight, shortened about two inches; good movement existed at the hip; and she could walk with much ease. Constitutionally, she was in perfect health. In two other cases I have successfully removed large portions of the acetabulum and of the contiguous portions of the ilium and ischium. In cases such as these, the result, if they are left to themselves, must inevitably be fatal. There is no danger of laying open the pelvic cavity during the removal of these masses of pelvic bone; for, as Hancock has shown, during the progress of the disease, the fasciæ, muscles, &c., lining the pelvis, become so thickened and infiltrated with plastic matter, that they form a barrier which effectually protects the pelvic cavity.



Fig. 280.—Result of Operation for Extensive Acetabular Coxalgia.

Method of Operating.—From the preceding considerations, it will be observed that there are two distinct operations practised on the coxo-femoral articulations. The first is simple resection of the epiphysis of the thigh-bone; the second, the removal of more or less of the acetabulum and of the contiguous pelvic bones as well. For the removal of the epiphysis of the thigh-bone only the following plan should be pursued. The patient lies on the sound side. If the disease be femoral, the gluteal region perforated with sinuses, and the soft parts thinned, the head of the bone lying dislocated on the dorsum ilii, it suffices to pass a director down one of the chief sinuses leading to the carious bone, and to slit this up. If, however, the bone be more thickly covered, and be not easily reached with the probe, and if the sinuses open on the thigh at some considerable distance from the seat of disease, then a T-shaped incision should be made over the upper end of the thigh-bone, so as to expose it (Fig. 281). The limb should now be forcibly



Fig. 281.—Excision in Femoral Coxalgia.

adducted, rotated inwards and pushed upwards by an assistant, and the soft structures separated by a probe-pointed knife from around the upper end of the bone, so that the whole amount of disease may come into view. The carious epiphysis is then cut off with a saw, the soft parts around being protected, if necessary, by means of retractors.

There is one practical question with regard to the amount of the upper end of the thigh-bone to be removed, which requires consideration; and that is, Should the bone be sawn through below the great trochanter; or through the neck only, leaving the trochanter? The practice should, I think, differ according to the nature of the disease. If this be femoral, it is best to take away the great trochanter, as the caries has generally reached its cancellous structure, or it may be infiltrated with tubercle. But if the disease be acetabular, and the pelvic bones be the parts most extensively and deeply affected, it will suffice to remove the head only, leaving the trochanter, which is not affected in these cases. After removing the head of the bone, the upper end should be examined, and any carious parts gouged out. After the epiphysis of the thigh-bone has been removed, the acetabulum must be examined, and any rough or necrosed bone lying at its edge should be gouged away.

In the acetabular form of the disease, where large portions of the pelvic bones require removal, the early stages of the operation require to be conducted in the way just described; the incisions, however, being made more freely, but not carried so far forwards as to endanger the anterior crural, or so far back as to wound the sciatic nerve. After the removal of the head of the thigh-bone, all loose necrosed pieces are to be taken out, and then, by means of ordinary cutting or gouge-forceps, the acetabulum and other carious osseous structures cut away piecemeal. Those portions of bone which have necrosed are usually separated, and lying loose, or else may generally be readily separated by the finger, or by the handle of a scalpel, from the subjacent soft structures; and the muscles and fascia lining the pelvic bones, being thickened and infiltrated with lymph, effectually protect the contained parts from all injury.

After the operation the wound must be dressed in a simple manner, and a long splint applied. Fergusson recommends that the extension should be made from the opposite thigh, round the upper part of which a socket



Fig. 282.—Dressing after Excision of Hip Joint.

is fixed, to which the band is attached (Fig. 282). Much advantage will be derived from the use of the bracket thigh-splint.

Results.—The result of excision of the hip joint has to be considered from two points of view:—1. So far as the mortality immediately referrible to the operation is concerned; and 2. As to the utility of the limb that is left after its performance.

1. As to the fatality directly referrible to the operation itself, it is diffi-

to bear moving into bed. Nevertheless, by the free use of stimulants and supporting food, she recovered rapidly, and when I saw her, nearly three years afterwards, the last presented the appearance in this drawing (Fig. 230), it was straight, shortened about two inches, good movements existed at the hip, and she could walk with much ease. Constitutionally, she was in perfect health. In two other cases I have successfully removed large portions of the acetabulum and of the contiguous portions of the ilium and ischium. In cases such as these, the result, if they are left to themselves, must inevitably be fatal. There is no danger of laying open the pelvic cavity during the removal of these masses of pelvic bone; for, as Hancock has shown, during the progress of the disease, the ligaments, muscles, &c., lining the pelvis, become so thickened and infiltrated with plastic matter, that they form a barrier which effectually protects the pelvic cavity.



Fig. 230.—Result of Operation for Extensive Acetabular Coxalgia.

Method of Operating.—From the preceding considerations, it will be observed that there are two distinct operations practised on the coxo-femoral articulations. The first is simple resection of the epiphysis of the thigh-bone; the second, the removal of more or less of the acetabulum and of the contiguous pelvic bones as well. For the removal of the epiphysis of the thigh-bone only the following plan should be pursued. The patient lies on the sound side. If the disease be femoral, the gluteal region perforated with sinuses, and the soft parts thinned, the head of the bone lying dislocated on the dorsum ilii, it suffices to pass a director down one of the chief sinuses leading to the carious bone, and to slit this up. If, however, the bone be more thickly covered, and be not easily reached with the probe, and if the sinuses open on the thigh at some considerable distance from the seat of disease, then a T-shaped incision should be made over the upper end of the thigh bone, so as to expose it (Fig. 281). The limb should now be forcibly



Fig. 281.—Excision in Femoral Coxalgia.

disease; but a little careful examination with the probe and by manipulation of the limb, will soon convince the surgeon that the joint is free from disease, and that the morbid action is limited to the trochanter, and possibly the root of the neck of the thigh-bone. In such cases the diseased osseous structures may be successfully gouged away, after having been freely exposed by slitting up the sinuses leading to them. In such operations I have not only successfully removed the greater part of the trochanter, but have even scooped out a portion of the interior of the carious neck of the thigh-bone at its trochanteric end; thus preventing the inevitable disorganisation of the hip-joint which would have resulted if the carious bone had been allowed to remain in close proximity to the articulation. In this operation the surgeon necessarily comes into very close proximity with the capsule of the joint; and unless great care be taken this might be opened, and thus the very mischief induced which the operation is undertaken to prevent.

In strumous children long sinuses will occasionally form about the great trochanter and gluteal region, leading to the supposition that there is caries of the bones in the vicinity of the hip-joint. The movements of the articulation will, however, be found to be perfectly free, and the most careful examination with the probe fails to detect osseous disease.

CHAPTER LIII.

DISEASES OF SYNOVIAL MEMBRANES, AND OF MUSCLES.

DISEASES OF BURSÆ.

THE bursæ which naturally exist, either under the skin, beneath the muscles and ligaments, or around tendons, are subject to various diseases. Not only do the normal bursæ become affected, but these sacs are sometimes developed from continued friction in situations where they are not naturally met with, and here also they may undergo disease; thus, for instance, bursæ have been found to be formed at the projecting point of a hump-back, on the prominent parts of club-feet, or at the extremity of stumps.

SITUATIONS IN WHICH BURSÆ EXIST.—In the following situations bursæ naturally occur, and may consequently be expected to be met with in a diseased state:—behind the angle of the lower jaw, on the symphysis of the chin, on the angle of the thyroid cartilage; on the acromion, the external and internal condyles of the humerus, the olecranon, the styloid processes of the ulna and radius; on the dorsal surface of the metacarpo-phalangeal articulations, as well as on their palmar surfaces, and on the dorsal aspect of the phalangeal articulations; on the anterior superior spine of the ilium, the great trochanter, the tuberosity of the ischium, the lower, superior, and outer parts of the patella; on each condyle of the thigh-bone the tuberosity of the tibia, the two malleoli, the calcaneum, the dorsal aspect of the toes, and on the plantar aspect of the heads of the first and fifth metatarsal bones. Besides these situations, they occur under the deltoid and the gluteus maximus, between the lower end of the scapula and the latissimus dorsi, and in the ham.

MORBID ALTERATIONS.—The continued irritation of bursæ by the pressure that is exercised upon them, may cause them to inflame, to enlarge, to become thickened, or to undergo various changes in structure. This enlargement of the bursæ in particular situations is often connected with special employments, by which continuous and severe pressure is exercised upon

certain parts of the body; thus frequent kneeling will occasion enlargement of the bursa patellæ, hence called "housemaid's knee." Miners are occasionally subject to an enlargement of the bursa lying over the olecranon, called "miner's elbow;" and in any situation a new bursa may be formed by continuous pressure and friction conjoined.

The four following pathological conditions may occur in the bursæ in any part of the body.

1. The bursa may, in consequence of continued pressure or irritation, become simply enlarged and filled by the excessive secretion of a clear sero-synovial straw-coloured fluid.

2. Inflammation may take place in the bursa with or without previous enlargement. The inflammation so set up speedily runs on to suppuration; and when the tumour is opened, fluid, consisting of an admixture of the bursal excretion and pus, escapes. The bursa, when its contents have suppurated, may either give way externally, pointing like an ordinary abscess, and the integuments covering it sloughing; or the pus may escape subcutaneously, and form a widely spread abscess around the part.

3. The enlarged bursa may contain a dark fluid, usually of a brownish colour, with a large number of small flattened elongated bodies, of about the size of grains of rice or of melon-seeds, floating in it. These bodies are of a fibroid or fibro-plastic structure, resembling masses of imperfectly developed exudation cells, and are apparently portions of disintegrated lymph.

4. The wall of the bursa may gradually thicken by the deposit of lowly organised lymph in its interior, until the tumour becomes perfectly solid, or at most contains but a small cavity with a little serous fluid in its centre. The section of a bursa thus solidified presents a laminated or foliated appearance.

Burgomas.—Enlarged bursæ are readily recognised; forming, whilst their contents are thin and serous, indolent oval tumours with distinct fluctuation, commonly occurring in the situation of some of the normal bursæ. As they become more solid they become elastic and hard, and often crackle on being pressed when they contain the rice shaped bodies; but at last they acquire all the characters of an ordinary solid growth, as the deposition within them increases. Not unfrequently these enlarged bursæ inflame, or, indeed, an attack of inflammation in them may be the first cause of their enlargement. In either case they become hot and tense; the skin covering them is red, often doughy and cedematous; and although there is no connection between the bursa and the neighbouring joint, yet it may happen that the inflammatory action spreads to the latter, from simple continuity of tissue. Suppuration very frequently occurs in an inflamed bursa; the tension increases, the œdema and redness become more considerable, and the pain assumes a throbbing character. When the bursa is opened, thick pus, often mixed with shreds of sloughy tissue, is evacuated.

Treatment.—The treatment of these bursal tumours must depend entirely upon their nature and actual condition. When they are inflamed, rest, the application of leeches, followed by tepid lead-lotions or poultices, and general antiphlogistic treatment, will commonly subdue the increased action.

If suppuration take place, they must be freely opened and the pus evacuated. When they are in an indolent condition, the surgeon has the choice of various plans of treatment, conducted on different principles. If the sac be thin, the fluid of a serous character, and the disease recent, it may often be removed by blistering, more particularly when it occurs in the *ham* or *under the deltoid muscle*. In some cases it may conveniently be

obliterated by puncturing the cyst, and then employing pressure upon it. The surest mode, however, of closing the sac consists in exciting inflammation in it, either by the injection of iodine as recommended by Velpéau, or by passing a small seton through it. The injection is readily effected by tapping the cyst with a moderate-sized trochar, and then throwing in about a drachm of the compound tincture. Inflammation will be excited, some discharge will usually take place, and on its cessation the walls of the cyst will have become agglutinated together. In these cases I generally prefer, however, as the most certain method, the introduction of a seton composed of a double silk thread. This may conveniently be passed through the cannula after tapping the sac, in the way figured in page 421; a poultice should afterwards be applied, and the threads left in for about six days. Discharge will take place through the aperture by which they have been introduced, and which may, if necessary, be enlarged; the cyst gradually contracts around them, and after their removal it will be found to be closed. When the cyst contains a number of the rice-like bodies, the seton may still be used, but it should be thicker than that just recommended, and the aperture by which it is introduced should be very free, in order to admit of the escape of the pus and granules.

If the walls of the cyst be very thick, or its contents semi-solid, or if the tumour have become solid, it must be dissected out. This operation is most commonly required for solid bursal tumours, situated over the patella or the tuberosities of the ischium; from both of these situations they may be removed with facility.

DISEASES OF THE BURSA PATELLÆ.—The exposed situation of the bursa patellæ, covered as it is only by the integumental structures and fascia lata, and its liability to pressure and irritation in kneeling, render it in all respects more prone to take on diseased action than any other similar structure in the human body; and the morbid conditions which it presents may be looked upon as typical to a great extent of the diseases of the bursæ generally.

The various affections to which this bursa is liable, may be divided into two classes: 1. Inflammatory Affections; and 2. Enlargements, of a Fluid or of a Solid character.

1. INFLAMMATORY AFFECTIONS.—This bursa is frequently the seat of *Simple Inflammation*. Undue pressure in kneeling upon a hard, irregular, and cold surface, such as stone, is likely to excite inflammation; hence its frequency in housemaids, whose occupation obliges them to kneel a great deal on floors and stone steps; and hence, also, the common title of "housemaid's knee," given to this and to many other affections of this bursa. But this disease, although frequent amongst, is not limited to housemaids; for it occurs in females following other occupations, and in men as well as in women.

In simple inflammation, however occasioned, the bursa becomes rather suddenly swollen, tense, red, and hot, with some fluctuation deeply under the integuments. The swelling, heat, fluctuation, and redness, often of a dusky colour, all situated in front of the patella, point out the nature of the affection.

The *Treatment* of this inflammation is simple enough. Leeches, followed by evaporating lotions, and keeping the patient at rest, are the means to be employed. Under this treatment, the disease will frequently undergo resolution in the course of a few days. It may, however, go on to suppuration, disease of the patella itself, or sloughing of the bursa.

Suppuration of the Bursa occurs in perhaps the majority of cases of inflam-

mation. This is a matter of great consequence ; because the accumulation of pus, being of large size, and tending to diffuse itself around the knee-joint, is liable to be mistaken for abscess in that articulation. Sometimes it will point, and the pus discharge itself externally in the usual manner ; but very generally it gives way subcutaneously, and its contents speedily diffuse themselves somewhat widely around the joint.

The history of the case affords the means of diagnosis. In suppuration of the bursa patellæ, the abscess commences by a superficial swelling and inflammation in front of the knee, which, after a time, extends laterally, enveloping the joint, the fluid gravitating on each side, but more especially on the outer one, nearly as far, perhaps, as the ham-strings. There will have been none of the signs indicative of acute arthritis accompanying the formation of this large abscess ; no startings of the limb, no laxity or pain in moving the articulation, no grating of the articular ends ; and little if any constitutional disturbance. The movements of flexion and extension of the joint are free up to a certain point, where they are checked by the mechanical obstacle of the purulent accumulation. But perhaps the more important diagnostic sign is the relation of the abscess to the patella. In a suppurating bursa, the patella is invisible, being covered by the fluctuating swelling ; in effusion, whether synovial or purulent, into the joint, the patella is above, floating upon the fluid.

The *Treatment* of this condition is simple enough. A free incision should be made through the anterior part of the bursa, so as to let out the pus mixed with synovial fluid ; and if there be any burrowing of matter, as there almost invariably is, counter-openings must be made in proper dependent situations.

Disease of the Patella.—Sometimes, but very rarely, abscess of the bursa patellæ will go on to disease of the patella itself. Caries of this bone secondary to suppuration of the bursa is, so far as my experience goes, exceedingly rare. I have seen one case of the kind—that of a woman who was in the Hospital, under my care, several years ago. When admitted, she had several fistulous openings on the fore part of the knee-joint, through which the probe led down to a rough and carious patella. On inquiry, it was ascertained that she had had inflammation of the bursa patellæ—"house-maid's knee"—which had run on to suppuration, but that the abscess had never been freely laid open. The present condition had resulted from that suppuration. The joint itself was unaffected ; there was no pain in it, and its movements were perfectly free. I laid open the sinuses, and, finding the anterior surface of the patella soft and carious, removed with the gouge the diseased bone to which they led. About two or three weeks after this, the joint became suddenly swollen, evidently filled with pus, and the seat of acute pain. In consequence of the severity of the symptoms, it became necessary to remove the limb above the knee. After amputation, it was found that the morbid action had extended through the patellar cartilage, perforating it by a small aperture, and so giving rise to suppuration within the joint.

Sloughing of the Bursa Patellæ occasionally occurs as the result of its inflammation and suppuration. A woman was admitted into the Hospital, in whom this bursa had inflamed and suppurated ; and not only the bursa but also the integuments covering it had sloughed away, leaving in front of the knee a circular ulcer as large as the palm of the hand, having a flabby surface, and undermined, purple edges. The patella was not exposed. Under ordinary treatment, the ulcer slowly healed, but no vestige of bursa was left.

2. **ENLARGEMENTS.**—We now proceed to the consideration of the second class of diseases of the bursa patellæ—those in which there is no inflammation, but in which there is enlargement of the bursa, owing to the accumulation within it of bursal fluid, of this fluid mixed with solid bodies, or of solid fibroid deposits.

Simple Enlargement.—The bursa may present a simple enlargement, dependent on the accumulation of fluid in its interior. Continued pressure exercised upon the bursa, as in kneeling, is the common cause of this affection (hence its frequent occurrence amongst housemaids), and constitutes the true “housemaid’s knee.” But it is also common amongst other people, whose vocation necessitates long-continued kneeling. One case of the affection in University College Hospital was in a carpet-layer; it was to all intents and purposes a “housemaid’s knee,” and the tumour equalled in size an ordinary orange. A man, aged thirty, who, in consequence of habitually kneeling upon the left knee in laying down carpets, had a tumour there as large as an orange, indolent, soft, and fluctuating to the feel, evidently an enlarged bursa, was admitted into the hospital. It was tapped by means of a trocar, clear fluid was drawn off, and a seton was passed through the cannula, and left in for six or seven days. Suppuration took place along the seton, the tumour collapsed and contracted, and the patient left the Hospital, cured, on the twelfth day.

With regard to the *Pathological Nature* of the disease, it would seem to consist in excessive secretion into the interior of the bursa, which becomes enlarged, thickened, and filled with a clear sero-synovial fluid.

The *Treatment* of these tumours is very simple. In some cases the application of tincture of iodine, or the ammoniacum and mercury plaster, or blistering, will succeed in inducing absorption of the contained fluid. If these fail, as they very often do, or if their use be too tedious, a very simple, and at the same time a very safe and successful, mode of treatment consists in tapping the tumour with the trocar, and passing a seton through the cannula, either by means of a long straight needle, or by using an eyed probe, and cutting down upon the end of it with a scalpel. The seton threads should be left in for a week or ten days—at all events, until they excite free suppuration. This treatment is exceedingly simple, and perfectly certain in its results. The only point to be attended to is, to keep the apertures by which the seton passes sufficiently patent to allow the free escape of any fluid which may collect in the interior of the bursa before it is closed. This is especially to be observed with the lower opening, which is apt to become blocked up.

Chronic Enlargement.—The next affection to which the bursa patellæ is liable is closely allied to the last, and appears to be an advanced degree of it. It consists in a chronic enlargement of the bursa, the coats of which are much thickened. The contents of the bursa, so enlarged, consist of a dark fluid, in which float a number of smooth oval bodies, of the size and shape of melon-seeds. I have seen this condition in both the male and the female. It may be distinguished from simple enlargement of the bursa, by the peculiar crackling sensation which is communicated to the hand when the tumour is manipulated. This arises from the melon-seed bodies floating about and rubbing against each other.

The *Pathology* of this affection is as follows. There is enlargement of the bursa, and excessive secretion into its interior of simple synovial fluid; this, however, is dark-coloured, probably from admixture of blood which has undergone disintegration. This fluid will be found to contain a large quantity of cholesteroline, broken-up blood corpuscles, and granules. The

melon-seed bodies are composed of lowly organised fibroid matter mixed with cholesterine, and are probably separated from the wall of the bursa.

Solid Tumours may be formed in connection with the bursa patellæ. By many these are supposed to be the result of the deposition of a fibroid material, which gradually takes the place of the fluid of an ordinary "house-maid's knee," and which, instead of taking the form of melon-seed bodies, is deposited in concentric masses, and thus accumulated in the interior of the cyst. This has not been the case, however, in many instances that I have seen. In these cases I believe there is a true fibroid deposit in the bursa from the very first; the tumour is never fluid, but hard and solid from the commencement, and continues slowly to augment in size, until it occasions sufficient inconvenience to require removal. In some cases there has been a previous syphilitic taint; the patient complains of pain in the tumour like that which is experienced in nodes, and it is by no means impossible that there may be a syphilitic origin for these tumours. However that may be, in the cases that have fallen under my observation, the tumours have never been fluid, nor have they originated in pressure, but appear to have been primary deposits of fibroid matter.

Treatment.—There is nothing to be done with such tumours but to dissect them out. This may be required in one or in both knees. With the most ordinary care the joint runs but little risk; but much trouble may arise from opening up that layer of deep fascia which, after surrounding the knee, is fixed to the borders of the patella. Such an accident is liable to be followed by infiltration and deep abscess in the ham, and is to be avoided by keeping the scalpel well towards the centre of the patella when operating.

Bunion.—When the bursa which lies towards the plantar surface of the head of the metatarsal bone of the great toe becomes enlarged, or when a new serous sac is formed upon the inner and posterior aspect of this bone, the disease termed a *bunion* occurs. In this affection, the enlargement of the bursa is usually secondary to an alteration in the shape and position of the great toe, which, in consequence of the pressure of narrow-pointed boots, has been thrown outwards in an oblique direction, so as to lie over or under some of the contiguous digits (Fig. 283); in this way a sharp angle is formed at the junction between the first phalanx and the metatarsal bone of the great toe. This angle, being constantly pressed upon by the boot, becomes irritated; and, for its protection, the bursa that is there naturally situated becomes enlarged, or an adventitious one forms. From time to time the bursa and the projecting angle become irritated and inflamed; and the morbid action thus set up may run on to suppuration of a very troublesome kind, a thin, unhealthy pus being formed, which is discharged through an opening that speedily becomes fistulous, and may degenerate into a most troublesome indolent sore.

Treatment.—In the treatment of this affection, the first thing to be done is to change the direction of the toe by wearing properly shaped boots, made with the inner side of the sole straight from the toe to the heel. If accidental inflammation be excited in the part, it must be allayed by the application of leeches, warm foot-baths, and poulticing; the cutaneous irritation that is left may best be removed by painting the surface with a strong



Fig. 283 — Bunion

solution of nitrate of silver. The faulty direction of the toe may best be remedied by using the ingenious contrivance described by Mr. Bigg, the action of which consists in drawing the everted end of the toe inwards by the constant action of a slender steel spring. Should these means fail, the position of the toe may be remedied by the division of the external lateral ligament of the metatarsophalangeal articulation, or of the tendon of the adductor pollicis, or the inner head of the flexor brevis pollicis; the toe, when restored to its position, being for a time kept fixed upon an under-splint.

DISEASES OF SHEATHS OF TENDONS.

The synovial sacs connected with the sheaths of tendons, are liable to two forms of disease: viz., the accumulating of fluid in the interior of the sac, forming a cystic swelling, known by the name of Ganglion; and acute and chronic inflammation, or Tenosynovitis. The tendons of the hand are most liable to both these affections.

Ganglion.—Two distinct kinds of ganglion are met with: the *Simple*, situated upon the sheaths of tendons; and the *Compound*, consisting in a dilatation of the sheath itself.

Simple Ganglion consists of a cyst varying in size from a cherry-stone to a large marble, and containing a clear transparent fluid of a yellowish colour, which is sometimes thin and serous, sometimes gelatinous and semi-coagulated. It occurs as a smooth, globular, elastic, and tense tumour, usually situated on the back of the wrist, where it forms a distinct round projection; it may also occur on the dorsum of the foot. In both situations it is distinctly connected with the sheaths of the extensor tendons; and, indeed, Paget looks upon it as being a cystic transformation of the fringed process of synovial membrane lining these sheaths. As ganglion increases in size, it often gives rise to painful sensations in the parts below it, by pressing upon the neighbouring nerves; thus, a ganglion at the back of the wrist often produces pain and weakness in the hand, by compressing some of the branches of the musculo-spiral nerve which are stretched over it.

Compound Ganglion is chiefly met with in the palm of the hand, and the dorsum, sole, or inner side of the foot. It consists of a dilatation of the sheaths of the tendons in these situations, and may often attain a very considerable bulk, and then usually becomes irregular in shape, owing to several tendons being implicated by it. Often, in this form of ganglion, the sheath is simply thickened as well as dilated, and the contained fluid is clear and yellowish, though usually thinner than in the simple ganglion. The sheath itself is vascular, and lined by a red, fringed, and velvety membrane, the fluid may then be dark and bloody, and contain masses of buff-coloured fibrine or a large number of granular bodies, like those met with in certain forms of enlarged bursæ. These I have found to be composed of imperfectly developed granulations, in which the remains of blood-vessels were visible, probably thrown off from the inner wall of the vascular sheath. This form of the disease, at times, puts on almost a malignant appearance, is extremely chronic in its characters, and may occupy a very extensive surface; in a case of the kind that was under my care some time ago, the dorsum and greater part of the inner side of the foot were involved.

Treatment.—The treatment of a ganglion must depend upon its character and size. When small and simple, as on the back of the wrist, it may commonly be got rid of by being ruptured by forcible pressure with the thumb, or by a blow with the back of a book, or by being tightly com-

pressed, by means of a sixpence wrapped in a piece of lint and firmly strapped upon the swelling. If it do not disappear in this way, the best plan is to puncture it subcutaneously by means of a valvular opening, to squeeze out its contents, scarify the interior of the cyst, and employ pressure. If the ganglion give rise to much pain and weakness, and cannot be made to disappear by the use of the means just indicated, it may usually be very conveniently and safely obliterated by passing a seton of two threads through it, and leaving it in for four or five days, until sufficient inflammatory action has been induced for the obliteration of the cyst. Should this means fail, it may be dissected out, if it be thought advisable to have recourse to this somewhat severe procedure, which is attended with some risk of inflammation extending up the sheath of the tendon. I have, however, on several occasions performed this operation, without any troublesome consequences ensuing.

A Ganglion situated in the Palm of the Hand, and extending under the annular ligament some little distance up the flexor tendons of the forearm, is a very troublesome disease. Syme recommends that the cyst should be laid open, and the annular ligament divided. This seems to me an unnecessarily severe procedure; and I have in several instances cured the affection by milder means: in one, by injecting a small quantity of tincture of iodine into the cyst through a puncture in the palm, and in two or three other cases by the use of the seton. The seton is most easily introduced by squeezing the fluid from the palm into the sheaths of the flexor tendons above the wrist, making a puncture into these, and then pushing an eyed probe armed with two or three threads along the tendons under the annular ligament into the centre of the palm, where it is to be drawn out through a small incision made down upon it.

In the *Side and Sole of the Foot* these ganglionic tumours, when of large size, and filled with semi solid fibrinous matter, may require to be dissected out.

INFLAMMATION OF THE SHEATHS OF TENDONS—TENOSYNOVITIS.—This is occasionally met with as the result of strains and twists of the hand, about the wrist, of the extensor tendons, or the long head of the biceps. In this affection there is swelling of a puffy character, with tenderness when the part is pressed on or moved; and usually a peculiar fine crackling sensation is communicated to the surgeon's hand when he examines the affected part. The crackling is especially marked in cases in which the inflammation and effusion have become chronic, when the disease appears to partake of the nature of a diffused ganglion.

Treatment.—The treatment, when the disease is acute, consists in leeching and blistering, with rest of the part; when it has assumed a chronic character, the application of blisters and the mercury and ammoniacum plaster will be found most useful.

DISEASES OF MUSCLES.

The voluntary muscles are not often the seat of primary disease of any kind. *Inflammatory affections* of muscles of a rheumatic character undoubtedly occur, and abscess is occasionally met with inside muscular sheaths, more particularly that of the rectus abdominis. *Syphilitic tumours*, or rather inflammatory or plastic indurations of muscles, are not very unfrequently met with.

Tumours of Muscle.—Organic structural diseases of muscular tissue are rare, yet the records of Surgery contain scattered through them no inconsiderable number of cases. My friend and former pupil, Mr. Teevan, has, with much industry, collected the particulars of 62 cases of Tumours of Muscles of all kinds. About one third of these he finds to have been can-

cerous; 16 were fibrous; 8 cystic; 5 hydatid; and 5 erectile. The form of cancer that occurs primarily in muscles is, I believe, invariably the encephaloid. I have most frequently seen the muscles of the lower extremity the seat of organic disease. When the upper limbs are affected, the muscles that have, according to Mr. Teevan, been most frequently attacked are the pectoralis major, deltoid, and biceps. The muscles of the trunk and neck are seldom diseased, with the exception of the rectus abdominis, which appears to be very liable to tumours.

I have had under my care seven cases in which tumours of different kinds developed primarily in muscular tissue. The first case was that of a woman, about 48 years of age, in whom a fibro-cystic tumour, as large as a coconut, developed in connection with the tensor vaginæ femoris, forming a large mass, which I dissected out readily from over the hip. The second case was that of a lad about 18, in whom a cystic tumour, as large as a fetal head, thick walled, and containing clear fluid, developed in the substance of the adductor brevis of the thigh, from which it was dissected out with no little difficulty, and with a fatal result. The third case was that of a man from whom the accompanying drawings are taken (Figs. 284,

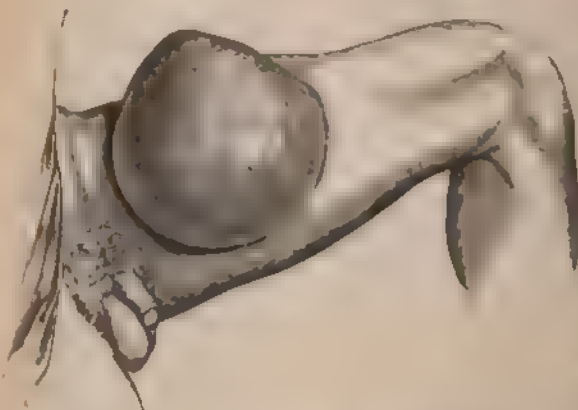


Fig. 284.—Fibro-Plastic Tumour of the Sartorius Muscle

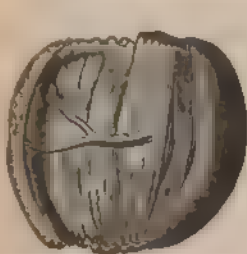


Fig. 285.—Back View of Tumour, showing Sartorius Muscle



Fig. 286.—Front View of Tumour, laid open, and showing Sartorius, &c.

285, 286), in whom a fibro-plastic tumour developed within the sheath of and in the substance of the sartorius muscle of the left thigh, in consequence of a strain. After growing slowly for about six years, it had attained the size of a child's head, when I removed it, together with seven or eight inches of the muscle from the inside of the sheath of which it had originated, and with which it was closely incorporated. The sheath of the femoral vessels, which was exposed for a considerable extent,

was unaffected by the disease. Recurrence took place in less than twelve months in the cicatrix, and when the secondary tumour had attained the size of an ostrich's egg, it was removed, the patient making a good recovery, but recurrence of the disease took place, which eventually proved fatal.

The fourth case was that of a man aged about 40, in the sole of whose foot a cystic tumour, about as large as a goose's egg, was developed, springing from the flexor brevis digitorum. This was carefully dissected out; but in a few months the patient returned, with a solid, elastic, rapidly growing tumour, evidently malignant, developed in the cicatrix. The foot was amputated, and on dissection the mass proved to be encephaloid, and to have developed from the muscular structure just named.

In two cases the tumours were hydatid. In one patient, a young woman, the disease was seated in the deltoid; in the other, a medical man, about 50 years of age, the tumour was seated at the outer edge of the latissimus dorsi. In both cases excision of the tumour was successfully practised.

In the seventh case the tumour was an enchondroma in the tibialis anticus. I have seen two other cases of enchondroma in muscles: one situated in the vastus externus of the thigh; the other, in connection with the pectoral muscle.

Tumours developing primarily in the intermuscular cellular planes are of very common occurrence; but these are very different from, and must not be confounded with, true muscular tumours.

The Treatment of these various muscular tumours must be considered on ordinary surgical principles. When of an innocent character, as cystic or hydatid, fibrous, erectile, or enchondromatous, they may be dissected out from the muscular tissue amongst which they lie, and no fear of recurrence need be entertained.

When they are malignant, amputation of the limb, if the tumour be favourably situated for such an operation, is usually the only resource: partial operations are usually worse than useless, as they lead to a speedy recurrence of the malignant action. Mr. Toevan has made the ingenious suggestion of applying to malignant tumours of muscle the same rule of practice that guides us in operations on bones affected by cancer; viz., to remove the whole of the organ that is the seat of disease, excising the entire muscle from its origin to its insertion, and thus eliminating from the system the whole of the morbid mass, which will be confined within its sheath—a structure that for a long time resists the outward pressure of a morbid growth. This suggestion is founded on correct pathological principles; the only objection to it is its difficulty of application in actual practice—there being few muscles so situated that they could with safety be completely extirpated.

CHAPTER LIV.

DEFORMITIES.

LATERAL CURVATURE OF THE SPINE.

THIS affection, on account of the frequency of its occurrence and the tediousness of its cure, has received a good deal of attention from various surgeons; and much has been written on it by those who have specially devoted themselves to its treatment; yet the whole of its pathology and management lie in a very narrow compass.

Lateral curvature of the spine most commonly commences at an early period of life, usually between the ages of twelve and eighteen—achieve

before the one, and not very commonly after the other. Girls are more frequently the subjects of this deformity, which but very rarely occurs in boys. It appears to consist simply in a relaxation of the muscles and ligaments of the spine; in consequence of which the vertebral column, being no longer able to support the weight of the head, neck, and shoulders, becomes curved to one side, a corresponding deviation taking place in the opposite direction at a lower portion of the spine, in order to preserve the equilibrium between the two sides of the body (Figs. 287, 288). The first curve

usually takes place in the upper or middle dorsal region, the convexity tending towards the right side; the second, or compensating curve, occurs in the lumbar region, the convexity looking towards the left. In some instances there is a quadruple curve (Fig. 289). At the same time that these lateral curves take place, there is a tendency to rotation of



Fig. 287.—Lateral Curvature and Rotation of Spina.



Fig. 288.—O-Aline of Double Lateral Curvature.



Fig. 289.—Quadruple Curve.

the bones of the spine upon one another, in such a way that the bodies of the vertebrae forming the dorsal curve are twisted slightly to the left, while those which enter into the formation of the lumbar curve are turned slightly to the right (Fig. 287). This twist is sometimes slight; but in other instances it is very marked, so that there is a double curvature—lateral and rotatory.

On examining the bones and intervertebral fibro-cartilages after death, even in cases of very considerable distortion, no disease will appear in them; except, perhaps, that the bodies of some may have been slightly compressed where they form the principal concavity of the arch. The ligaments appear to be stretched, relaxed, and somewhat weakened; and the muscles are usually pale, flabby, and apparently wanting in power.

MECHANISM. From a consideration of the pathology of this affection, and from the particular age at which it manifests itself, before the bones have become completely ossified, or the ligaments have acquired their due degree of rigidity, its mechanism becomes sufficiently apparent. The spinal column, being composed of a number of separate bones, possesses no firmness in itself, or power of self support, but is maintained in the erect position by the close manner in which its separate elements are knit together by ligamentous and

muscular structures, and by the way in which, when thus bound together as a whole, it is supported on each side by the strong mass of the erector spine muscles. The proper tension of these ligamentous supports and muscular masses, is especially necessary for it to maintain the weight of the head and shoulders, which is thrown on the cervical and the upper portion of the dorsal spine. If, from any cause, the ligaments become relaxed, and the muscles lose their tension, or if the weight of the upper part of the body increase disproportionately to the augmentation in the strength of the ligaments and muscles that support the spine, the vertebral column will necessarily give way under the pressure to which it is subjected in a direct line from above downwards, and will consequently become curved. Most commonly, indeed almost invariably, this takes place in a lateral direction, the spine yielding more readily in this than in any other. In some

rare cases, however, the lower portion of the cervical or the upper dorsal region will project backwards in an angular manner, constituting the disease termed *Cyphosis* (Fig. 290); and in other cases, of still less frequent occurrence, there may be incurvation of the spine in the dorso-lumbar region, giving rise to *Lordosis* (Fig. 291).

The directions in which these various curves take place are exaggerations of the natural inclination of the spinal column. In *lateral curvature*, the chief convexity takes place towards the right side, causing a projection of that shoulder which in most people is somewhat more prominent than the other. In *cyphosis*,



Fig. 290.—*Cyphosis*.

Fig. 291.—*Lordosis*.

the excurvation takes place in the lower cervical and upper dorsal regions, which are naturally prominent; and, in *lordosis*, the incurvation is most marked in the lumbar region, in which there is naturally a curve forwards.

CAUSES.—These various kinds of deformity, as has already been stated, chiefly occur in girls about the age of puberty; at a time of life when the tonicity of the muscular system not unfrequently becomes lessened by the occurrence of anemia and those states of impaired health that so frequently attend the establishment of the uterine function; and before the osseous and ligamentous structures of the body are fully developed. At this period of life, also, it frequently happens that the spine becomes rather suddenly elongated by a rapid increase in growth taking place; or that it becomes overweighted by the system developing itself, and the shoulders and bust becoming stont and expanded. Indeed, so frequent is the occurrence of a certain degree of lateral curvature of the spine from these various causes, about the age of puberty in girls, that few escape a tendency to deviation; of so slight a kind, however, as not to admit of recognition as a disease. But if this tendency be allowed to go on unchecked, or if it be increased by injurious habits, amongst which are all one-sided postures in which the body is twisted, as in playing some musical instruments, or in leaning over a table in drawing and writing, the slight deviation may rapidly increase until it assume the true characters of lateral curvature of the spine. I do not think that there is any evidence to show that this is either a strumous or a rickety affection; indeed, so far as my observation goes, I

should certainly say that strumous girls are less liable to the disease than those of a nervous or bilious temperament. A rickety tendency would, of course, increase the disposition to the affection; but I think this is very rarely associated with it. Amongst the more common predisposing causes must undoubtedly be reckoned the indolent and sedentary occupations, and the luxurious enervating habits that are commonly encouraged in girls in the higher ranks of life, and which, by preventing due muscular development, at the same time that they induce a general loss of tone in the system, may directly occasion the disease.

The causes of the antero-posterior curves are usually to be found in some faulty habits of the patient; either giving rise to an habitual stoop, and thus laying the foundation for cyphosis, or throwing too great a weight on the loins, and thus giving rise to lordosis. A kind of spurious lordosis is developed in some cases of ankylosis of the hip-joint.

SIGNS OF LATERAL CURVATURE.—The signs of this affection, when it is well marked, are distinctly obvious. The serpentine character of the curve, its double nature, the convexity on one side looking to the right shoulder, and on the other to the left loin, will render its nature evident. Most commonly it commences in a gradual manner, the first condition that frequently attracts attention being the prominence of the right scapula, which is supposed to be "growing out;" or the sterno-clavicular articulation on the same side, or some of the cartilages of the ribs, have been observed to project. Whenever the surgeon is consulted for such symptoms as these, he should at once examine the spine, which he will generally find to have an inclination to the right side. In the early stages of the disease, when the deviation is not very distinctly marked, the readiest mode of determining it is to let the patient stand up-right, taking care that the feet are well placed together, and that the attitude is not forced, but natural; the surgeon should then run his finger down the back from one spinous process to another, touching each as he passes it with a pen dipped in ink; in this way, when he has reached the lower part, he will have mapped out the course of the vertebral column, and thus may see at a glance the nature and extent of its displacement. At the same time, he will probably observe that the two hips do not exactly correspond, the left being somewhat thrown out. Very commonly there is a good deal of neuralgic tenderness about the spine, and at this early stage there may be anæmia and symptoms of impaired nutrition. As the disease advances, the curvature becomes more distinct, and at the same time, owing to the torsion of the column, assumes a slightly angular character where most convex.

The ribs on the right side are thrown out and bulging, and carry up the scapula

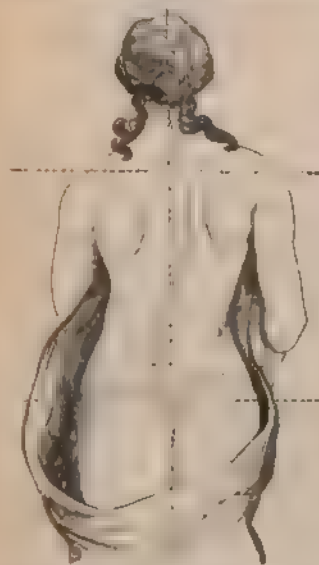


Fig 292.—Lateral Curvature of Spine

with them, whilst those on the left are sunk and depressed (Fig. 292). In fact, the whole of the right side of the chest and body partakes in the projection of the spine on that side, and thus adds much to the general de-

torquity; whilst the left side of the chest is correspondingly hollowed and sunk in. When the disease has advanced in this way, it always occasions great general debility, emaciation, and pallor; the nutrition of the body being impaired, partly by the compression to which the thoracic and abdominal organs are subjected, and partly, doubtless, by irritation set up in the spinal cord, induced by the curvature.

During the early part of the disease the spine preserves its flexibility; and whilst the curve is still recent, and the patient young, if the weight of the head and shoulders be taken off, it will at once resume its straight direction. Thus, if the patient be lifted off the ground by raising her up with the hands under the axillæ, or if she be laid down on her face on a flat couch, the back will fall into a straight position, or may readily be made to do so by slight traction. After the disease, however, has existed for some years, or if the patient have passed that age at which consolidation of the bones and ligaments takes place, the distortion will continue permanently, in whatever position she may be placed. This is not only owing to the deformity of the spine, but to the ribs, and ligamentous and muscular structures generally of the trunk, having become fixed in their abnormal position.

TREATMENT.—The treatment of lateral curvature of the spine should be conducted on rational principles; and when divested of the mystery with which some interested specialists have surrounded it, becomes as simple as that of any other chronic surgical affection of the bones, joints, or muscles. There are three principles of treatment that require to be carried out in the management of these cases. The first is the improvement of the general health,—unless this be effected, nothing can be done; the second is to strengthen the muscles of the spine; and the third, to take away as much as possible the weight of the head, neck, and upper extremities.

The administration of some of the milder preparations of iron, with a course of aloetics for the regulation of the uterine function, is of great moment; at the same time, a nourishing diet of animal food should be allowed, and the patient encouraged to take exercise in the open air. By these means the nutrition of the system will be improved, and the tone of the muscles greatly restored. The muscular power may be more directly strengthened by having the back well sponged with cold salt or vinegar and water every morning, and methodically rubbed from top to bottom. The friction should be principally directed to the erector spinae muscles on either side of the vertebral column, and may be done either with the naked hand, or with some slightly stimulating embrocation. At the same time, if the patient's strength will permit it, but not otherwise, the use of the hand-awing may be allowed, or calisthenic exercises practised; these, however, should not be continued if they induce a feeling of fatigue or exhaustion. Whilst this plan is being persevered in, the patient should be made to lie recumbent for a few hours daily, sitting or standing as little as possible. By these means, assiduously continued for some length of time, the muscles of the back may be strengthened, and the increase of the deformity prevented; and in this way the slighter cases of lateral curvature, those in which there is rather a tendency to than a full development of the disease, may be cured.

When the affection is further advanced, though the spine still continues flexible, if there be decided projection of the ribs on one side, and the shoulder and hip be prominent, with apparent difference in the length of the limbs, and much impairment of the general health, more decided measures of treatment must be had recourse to. In these cases, as in those just described, the constitutional powers must be carefully attended to on ordinary medical

principles; iron, and good living, with fresh air, being the basis of the treatment. At the same time that we endeavour to improve the strength of the system in this way, and that of the muscles of the back, specially by cold bathing and frictions, it is essential to adopt means to take off the weight of the head and shoulders, and to prevent its continuing to keep up and to increase the deformity. This may be done in two ways: by keeping the patient in the recumbent position, or by allowing her to go about, wearing proper supports.

The *recumbent position* in the treatment of lateral curvature of the spine, though a valuable means as an adjunct to other measures, has been greatly abused, by being employed as an exclusive plan. This, I think, should not be, except when the patient is unable to stand or walk with comfort, as happens in some of these cases, when it may be necessary to confine her for a time to this position, until the proper muscular power is restored by other means. These instances, however, are very rare; too much so to constitute the rule in the treatment. Whenever the recumbent position is employed, the prone seems to me far preferable to the supine, for reasons mentioned when speaking of angular curvature of the spine (p. 791); and the best couch for the purpose is certainly Verral's. The patient should be kept on this during the intervals of exercise, not being allowed to sit or stand, even at meals; she will very soon become accustomed to a position that at first appears constrained, and will, probably, speedily be enabled to sleep in it.

The *Mechanical Contrivances* constructed for the purpose of taking the weight of the head, neck, and other extremities, off from the weakened spine, are of very various forms, and have had much ingenuity expended in their construction. They all have three principal objects, however much their details may vary; viz.: 1, to take a broad basis of support round the pelvis, by means of a strong well-fitting band; 2, to carry off the weight of the head and upper extremities from the spine by means of lateral crutches, which transmit it to this band; and 3, to influence the con-

voxities of the spinal curve by means of movable plates, acted upon by rack-and-pinion or screw power. The best of these mechanical contrivances for supporting the weight of the head and shoulders, is the apparatus represented in the accompanying woodcut (Fig. 293), taken from an instrument constructed by Mr. Bigg. By it the projection of the right shoulder may be gradually brought down, the left one raised, and the weight of the whole of the upper part of the body supported. By this contrivance alone, properly and carefully adjusted to the condition of the deformity, most patients may be treated without the necessity of any confinement whatever, the spine being gradually restored to

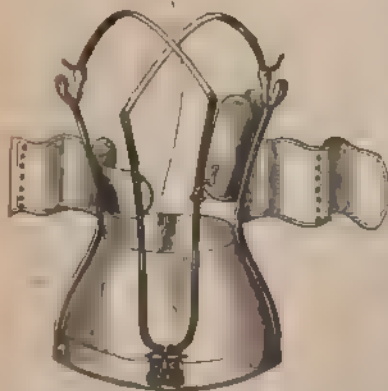


Fig. 293.—Spinal Support for Lateral Curvature

its proper direction by very gradually increasing the pressure and support of the instrument, at the same time that the general health is carefully

attended to, and the patient has the benefit of good air. At first the instrument need only be worn during the day, but after a time it should be kept on at night as well. In long standing and severe cases of lateral curvature of the spine, when its flexibility is lost, and the projection of the ribs has become permanent, a cure cannot be expected, nor can it be brought about by any means; but the patient will derive great comfort and support from the use of this excellent instrument, and the increase of the disease may thus be prevented.

The treatment of *Posterior Excurvation* of the spine, without caries or

other organic disease of the vertebral column, is best conducted by the use of the instrument here figured (Fig. 294), which is constructed essentially on the same principles as that for lateral curvature, with the exception that the backplate is so arranged as to press upon the projecting spine, and thus gradually to bring it into proper position.

In *Posterior Incurvation* the apparatus here figured (Fig. 295) will be found the most useful



Fig. 294.—Spinal Support for Posterior Excurvation.



Fig. 295.—Spinal Support for Posterior Incurvation.

appliance. In fact, all these varieties of spinal curvature may be successfully remedied by instruments constructed on the most simple mechanical principles, if carefully attended to and carried out.

CONTRACTIONS AND RETRACTIONS OF MUSCLES.

Under the head of *Muscular Contractions* are included various deformities, such as squint, wry-neck, club-foot, club-hand, some of which are congenital, others acquired. In all of these conditions, the deformity is primarily owing to an affection of the muscular system, and not to disease of the bones or ligaments, which are only secondarily implicated.

CAUSES.—The causes of these deformities are very various; but they may be referred to three heads.

1. *Continuous Faulty or Abnormal Position* of a limb, as in an unreduced dislocation or an ankylosed joint, will be followed by the disuse of a certain set of muscles, which consequently become shortened and atrophied, and acquire a rigid state. This condition is consecutive to the displacement, but renders it permanent; it is apt to occur after fractures, if the parts be kept for too long a time in one position, and more particularly if they be bound and matted together by the pressure of tight bandages. A somewhat similar cause sometimes operates on the fetus in utero; an abnormal position in the uterine cavity being very frequently the immediate occasion of some of the varieties of congenital club-foot. These deformities must not be confounded with congenital dislocations, in which there is always an arrest of development of some of the articular ends of the bones connected with the affected joint.

2. *Irritation set up in the Central Portions of the Nervous System*, may produce deformity by deranging the proper antagonistic action of certain

groups of muscles. This condition gives rise to many of the congenital as well as of the non-congenital deformities. It may act by producing more or less complete paralysis of one set of muscles, the contractility of their antagonists continuing normal; and thus, the relative balance of action being destroyed, the stronger will draw the part over to their side. The influence of this want of proper balance of parts in paralysis, producing deformity, may be well seen in palsy of the portio dura where the face is distorted by being drawn to the sound side; or in squint, where, the external rectus being paralysed, the eye is drawn inwards. According to Tamplin, deformity from paralysis is never congenital, though it is not unfrequently met with in the non-congenital cases. Central irritation may occasion deformity in another way, by producing tonic or permanent spasm of one set of muscles, the other remaining perfect in their contractility, but overbalanced by the continued contraction of their antagonists. This would appear to be the case in some forms of squint. Dr. Little has made the important observation, that many cases of deformity appear to be due to mischief inflicted on the base of the brain during protracted and instrumental labours.

3. *Peripheral Nervous Irritation* may occasion contraction of the muscles and deformity. This we commonly see happen in cases of contraction occurring from the irritation of worms in the intestinal canal, in the so-called hysterical contractions from uterine irritation, &c. From all these various causes contraction and deformity may arise. In some cases deformity will cease after the removal of the cause; but in other instances in which it has been of long duration, the deformity will continue, owing to the muscles having fallen into a kind of rigid atrophy, being shortened and wasted, and consequently unfitted for the proper exercise of the actions of the part.

TREATMENT.—The *General Treatment* of deformities consists in removing the cause of the contraction in those cases in which it is dependent on central, peripheral, or nervous irritation that admits of remedy. Thus, if squinting arise from pressure upon the brain, the eye will assume its straight direction when the congested vessels are relieved, or the effused fluids absorbed; or if a contraction of the ham-string muscles arise from the irritation of worms in the intestinal canal, a dose of purgative may cure the affection. When, however, the deformity is congenital or more permanent, the employment of *mechanical means* and the *Division of the Tendons* is the only mode of restoring the natural condition of the part. This *orthopædic* department of surgery owes, in a great measure, its existence to the labours of Delpech and Stromeyer, and its perfection to those of Little, Tamplin, and Adams.

TENOTOMY.—By tenotomy, as at present practised, is meant the subcutaneous division of a tendon by means of a very fine narrow-bladed knife (Fig. 296) introduced obliquely through a puncture by its side. In doing

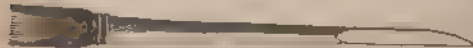


Fig. 296.—Tenotomy-knife.

this it should be borne in mind, that the normal anatomical relations of parts are often a good deal disturbed in cases of deformity; and thus tendons may be approximated to arteries and nerves, from which, in the healthy condition of the limb, they are widely separated. The tendon may most conveniently be divided, in the majority of cases, by introducing the blade beneath it sideways and then turning the edge against it, scratching through it by a kind of firm sawing movement, the handle of the knife being used

a lever to press the edge against the tendon, whilst the parts are made secure by an assistant. A drop or two only of blood are lost in this simple operation, and, as the divided tendon retracts with a kind of snap, a gap will be left between the two ends, from half an inch to an inch in width, according to the previous amount of tension in the part. If the muscles have been contracted for some years, it will commonly be found that the fasciæ in the neighbourhood of the tendon have become rigid and unyielding, forming cords or bands stretching across from the side of the gap. If these be very tense, they may be divided in the same way; but in many instances it will be found after a lapse of a short time that they will yield, and consequently will not require division. After the section has been made, the small puncture should be closed with a pad of lint and a strip of plaster, the admission of air into the wound being carefully guarded against. The whole success of the operation depends on this. Should air enter, inflammation and suppuration will to a certainty be set up; whereas, if this be avoided, the wound will heal by the effusion of plastic matter without any inflammation. It is the entry of air, and not the subcutaneous wound, that gives rise to inflammation. The part should then be left without any apparatus being applied for three or four days. At the expiration of this time lymph will have been thrown out, and then proper mechanical contrivances may be adjusted for gradually restoring the normal position of the limb or part; if this be done too soon, the cicatrix will be extended at too early a period after the deposit of the plastic matter, and the tendon will become weakened and too much elongated.

Chloroform is not always admissible in these operations. In some cases it will be found that the muscle under its influence becomes so much relaxed, that the defined edge of the tendon disappears, and the proper section cannot be made.

The mode of *Repair in Divided Tendons* has given rise to some controversy, there being two theories with regard to the process. According to one, the plastic matter deposited between the divided and retracted ends gradually undergoes a process of contraction, analogous to what takes place in the cicatrix of a burn, so as to cause approximation of the cut ends of the tendon at the expense of the muscle, which becomes partially lengthened, until at last a transverse linear cicatrix merely is left at the line of section. Adams has, however, conclusively shown that this theory is erroneous, and that repair is effected by the deposit of plastic matter between the cut ends, chiefly from the sheaths and soft parts around; that this plastic matter undergoes gradual transformation into tendinous tissue; and that the tendon is actually lengthened, and remains permanently so, by the deposit of this new material, which eventually resembles the normal structure of tendon so closely that the microscope fails to detect any appreciable difference in structure, and that it can only be distinguished by its more translucent appearance from the old tendon. In fact, the divided tendon is completely regenerated or reproduced.

In cases of congenital malformation, the question frequently arises as to whether tenotomy should be performed in early infancy, or delayed to a more advanced age. As a general rule, I think that, if imperative, the sooner these operations are done the better; they are not more difficult at an early period of life than at any other, no danger attends them, and when they are performed during infancy, there is a far less chance of the deformity being permanent, than if the operation be delayed for some years. But it must be remembered that many slight deformities and contractions in infants may be removed without operation, by attention to proper mechanical and

hygienic means. The surgeon should, therefore, not be too ready to operate in slight cases at tender ages.

DEFORMITIES AFFECTING THE FACE AND NECK.

SQUINT.—By *Squint* or *Strabismus* is meant a want of parallelism in the position and motion of the eyes. Most commonly a squint is convergent, the edge of the cornea being buried under the inner angle of the lids, more rarely the divergent form is met with. In convergent strabismus, one eye only is generally affected, but in some cases both are implicated, though one eye is almost invariably worse than the other; and this gives an appearance as if there were an alternation of squinting in the two eyes. In order to ascertain which eye squints, the simplest plan is to direct the patient to look at a distant object; when the sound eye only will be directed towards it, the affected one being turned inwards.

Causes.—Squint may arise from a variety of causes; it not unfrequently comes on in children after infantile complaints, such as measles or scarlatina, and, as Sir C. Bell has observed, commonly depends upon weakness of the external rectus, arising from some paralytic affection of the sixth nerve, seldom upon spasm of the internal rectus. In many cases it is indicative of disease of the brain or nervous centres, occasioning paralysis or irritation of the motor nerves of the eye; in other instances it may occur from the irritation of worms in the intestinal canal; and not unfrequently it is dependent upon some disease of the eyelids or eyeball. Thus the various inflammatory affections of the conjunctiva and eyelids may occasion it; or it may, as not unfrequently happens, when it occurs in adults, be dependent on difference in the focal length of vision, owing to amaurosis or the failure of sight in one eye; and lastly, in children it may be induced by habit or imitation.

Treatment.—The treatment of squint must to a certain extent be influenced by its cause. Thus, the removal of congestion of the brain or the expulsion of worms from the intestines may cure the affection; or, if it have followed simple debility in children, it will disappear as their strength improves, and they will thus outgrow it. If, however, the deformity be of a permanent character, it may readily be remedied by the simple operation introduced by Dieffenbach. The operation for squint should not, I think, be performed until the child has attained its eighth year, as it is not very easy to do it satisfactorily before this period, owing to the restlessness of infants; and, in very many instances, the squint gradually disappears as a child grows older, without recourse being had to any operative procedure. Indeed, in many cases it may be better to defer it till the adult age is reached. On the other hand, it should not be delayed too long, lest some contraction of the features or deformity in the other eye be left, and thus a very satisfactory result be not obtained. The operation is sufficiently simple; it may most conveniently be done by bandaging the sound eye, and then directing the patient to look outwards with the affected one; a fold of the conjunctiva near the inner canthus is then seized with the forceps, and snipped transversely with a pair of rather sharp-pointed scissors. By dilating the wound slightly with the scissor-blades, the tendon of the internal rectus will be exposed, which may be seized with the forceps, and readily cut across; or a very convenient plan consists in passing a curved director underneath it, raising it upon this, and then dividing it either with the scissors or a small curved bistoury. During the operation the eyelids must be held apart by an assistant, who may, if necessary, use the eye-speculum for this purpose. After the operation, a piece of wet lint should be laid upon the eye; and, if

any fungous granulations spring from the wound, they must be snipped off or touched with the nitrate of silver; some double vision may be left, but this gradually wears off. Critchett advocates the subcutaneous section of the muscle in strabismus, as being less likely to be followed by those inconveniences and deformities that attend its division in the ordinary way; viz., depression of the caruncle, slow healing, an unsightly cicatrix, and often more or less prominence and eversion, that are as disfiguring as the condition for which the operation is done.

WRY-NECK.—Wry-neck, *Torticollis*, or *Caput Obstipum*, arises from spasm of one of the sterno-mastoid muscles; the head being drawn to the affected side. On close examination in wry-neck it will be found that there is a triple displacement of the head, which is drawn downwards, rotated outwards, and inclined laterally towards the affected side. The features lose their symmetry; the half of the face, and even of the head, on the affected side, becomes less perfectly developed; the true line of the eyebrows, eyes, and mouth becomes displaced and lowered.

In torticollis the affected sterno-cleido-mastoid will be found hard, defined, and shortened; and sometimes both divisions of the muscle are equally tense, standing out in strong relief, so as almost to look like two distinct muscles. In other cases one division, and then most usually the sternal, is chiefly affected. After a time the cervical vertebrae participate in and maintain the displacement, becoming rotated on their axes and curved. Eventually the whole spinal column participates in the displacement, and lateral curvature sets in. The deeper muscles also become shortened, and the anterior margin and clavicular attachment of the trapezius will often be found tense and preternaturally defined.

Causes.—Wry-neck occasionally appears to be congenital: more frequently it is acquired, coming on in childhood after measles or scarlatina, or as a consequence of inflamed cervical glands. It not unfrequently commences with an ordinary stiff neck from cold. In whatever way it originates, the spinal accessory nerve is probably at fault, and it is owing to the irritation of it that the sterno-mastoid and trapezius muscles take on a spasmodic action. In spasm of both sterno-mastoids the head is thrown forwards, the muscles projecting in great relief. In these cases, the disease will usually be found to have had a rheumatic origin. Deformity in this situation may also occur from diseased cervical vertebrae, or from the traction of the cicatrix of a burn. The conditions here, however, are peculiar, depending upon causes that are irrespective of the state of the muscles, and may readily be distinguished from the true form of the disease produced by the causes above mentioned.

Treatment.—The treatment of torticollis arising from permanent spasm of one of the sterno-mastoids, which is the common form of the affection, may best be conducted by dividing the inferior attachment of the muscle, and thus allowing the head to regain its proper position. The division of the muscle is a somewhat delicate operation, on account of the important structures that lie immediately behind it. By making the incision, however, through it, from behind forwards, close to the sternum and along the clavicle, there can, if ordinary care be employed, be little risk of doing any damage, as these bones carry the lower attachment of the muscle forwards, and separate it from adjacent parts. The tension also into which it is thrown by its spasm draws it away from the carotid sheath. In several instances in which I have had occasion to perform this operation, no difficulty whatever has been experienced in dividing the sternal attachment of the muscle, which is usually very tense and prominent, by passing an

ordinary tenotome behind the tendon, with its flat side towards it, just in front of the upper margin of the sternum, and then cutting forwards, whilst the muscle is put well upon the stretch. In dividing the clavicular insertion, the safest plan, I think, consists in making a puncture with a scalpel upon and down to the clavicle in the cellular space which lies between the two attachments of the muscle, and then pushing a long blunt-pointed, narrow-bladed tenotome between that bone and the insertion of the muscle, dividing this in a direction forwards. Care must be taken to divide the muscle completely, but not to carry the incision too freely or deeply. I have heard of more than one case in which, from want of due precaution, abundant hemorrhage occurred, and of three in which fatal results followed the operation:

After the operation, the position of the head must be gradually rectified by proper apparatus (Fig. 297). The best instrument for this purpose is the one



Fig. 297.—Bigg's Apparatus for Wry-neck

invented by Mr. Bigg, and here figured. It consists of a pelvic band, a vertebral stem, and arm-pieces, the object of which is to secure a firm basis of support to the neck lever (1), and the maxillary lever (2). The neck lever passes round the head, and takes its bearing against the temporal bone on the side towards which the head is deflected. The maxillary lever acts against the lower jaw on the opposite side—that which is turned up. By means of a ratchet-joint the neck lever, the action of which is vertical, turns the head from the side to which it is deflected, whilst the maxillary lever, acting horizontally, rotates the head on its vertebral axis. By the combined action of these two forces the head is restored to its vertical position, and the chin replaced in the mesial line. In this way the curvature of the cervical vertebrae may gradually be corrected; should it, however, have existed for a considerable time, it may have assumed a permanent character, and a twist in the neck will continue for life. If the operation be not delayed too late in life, the features will gradually regain their symmetry. After the division of the tendon, the deep fascia of the neck will sometimes be found stretching across in firm and tense bands; these,

however, had better not be interfered with, as they will yield in time, and much risk of injuring the subclavian and carotid vessels would attend any attempt at their division. The exposure and division of the spinal accessory nerve has been practised, but not, I believe, with much benefit.

In those cases in which the wry-neck appears rather to be dependent on paralysis of one sterno-mastoid, than on spasm of the other, electricity, and the application of strychnine to a blistered surface over the muscle, will be found most useful.

DEFORMITIES OF THE ARM AND HAND.

CONTRACTION OF THE ARM is not of very common occurrence, except as the result of burns. I have, however, met with four distinct forms of contraction of the forearm:

1. There may be anchylosis of the elbow-joint, the forearm being bent at

a right angle with the arm, the result of disease of or around the articulation. If the ankylosis be fibrous, and the muscles strong and firm, a very useful limb may be restored by breaking down adhesions, under chloroform, by forcible flexion and extension, and then using passive motion, friction, and douches. Should the muscles be very flaccid and wasted, forcible extension may leave a permanently weakened limb, over which the patient has lost the power of flexion. In such cases I have found gradual extension, made by means of an angular splint, acted upon by a ratchet-apparatus, the safest means of restoring the utility of the arm. If the ankylosis be osseous, the bones should be resected, a wedge-shaped piece being sawn out, and a false joint allowed to form.

2. The biceps may, by its contraction, occasion a permanent flexion of the arm. This contraction of the biceps may be hysterical or rheumatic. When hysterical, occurring in young women, it requires the ordinary constitutional treatment of hysteria; should this fail in removing it, extension may be made under chloroform, and the arm kept in the straight position for a time. When it is rheumatic, or of organic character, and permanent, section of the tendon and its aponeurosis may be practised, due care being taken of the artery and nerve. This operation is most safely done by introducing the tenotome to the inner side of the tendon, slipping it under, and cutting upwards and outwards; the artery being guarded and pushed to the inner side by the pressure of the left forefinger.

3. The forearm may be forcibly pronated and flexed as the result of chronic inflammation of the radio-humeral articulation. Here forcible supination and extension, under chloroform, is the best remedy.

4. The forearm may be bent on the arm in consequence of the contraction of the cicatrix of a burn along the inside of the limb. In this case the plastic operation described at page 150 must be practised.

ANKYLOSIS OF THE ARM IN THE STRAIGHT POSITION is a condition of very serious inconvenience to the patient, the limb being almost useless for all ordinary purposes of life. In cases of this kind, the treatment to be adopted must depend upon whether the ankylosis be fibrous or osseous. If it be fibrous, however firm, the forearm may always readily be brought into a rectangular position by flexion under chloroform, and the mobility of the joint may then be improved or restored by passive motion, friction, and douches. If osseous, the bony union must be sawn across, and the case treated as an ordinary instance of excision of the elbow, with the view of establishing a false joint.

ACQUIRED CONTRACTION OF THE MUSCLES OF THE FOREARM IMPLICATING THE HAND is occasionally met with in adults. I have seen it in two opposite conditions; that of forcible extension (Fig. 208), and that of forcible flexion and pronation (Fig. 209). In both instances it appeared to have been the



Fig. 208 — Contraction of Extensors of the Hand

result of over use of certain muscles; in the first case in wringing out clothes, in the other in cutting with very heavy shears. In the case of flexion and pronation, it was interesting to observe that, when the fingers were extended, the wrist became flexed, and when the wrist was extended

the fingers became bent in. In these cases change of occupation, friction, and galvanism, with the use of a straight splint, were advantageously resorted to, a cure being eventually effected.



Fig. 399.—Contraction of Flexors and Pronators of the Hand.

CLUB-HAND.—A deformity resembling club-foot has occasionally, though very rarely, been met with in the hand. The contraction may occur in two directions: either in the sense of

preternatural flexion, or in that of abnormal extension of the member. It has been described by Cruveilhier, Voillermier, and Smith of Dublin. In most of the cases that have been met with, there was a certain amount of deformity of the lower end of the radius, with congenital dislocation of the wrist; and in Smith's case there was an accessory semilunar bone in the carpus. Little, if anything, can be done by surgery for the relief of this deformity; though some benefit might possibly result from the division of any tendons that were preternaturally tense.

CONTRACTION OF THE FINGERS.—A contraction of the fingers, which are drawn into the palm of the hand, is often met with. Most commonly this commences in the little finger, and thence gradually extends to the ring and middle fingers, which become so forcibly and firmly curved inwards, that their extension is not practicable. It commonly results from frequent and continued pressure on the palm of the hand, as in leaning on a round-ended stick in walking, or in those trades in which an instrument requires to be pressed into the hollow of the hand. In many cases, however, it occurs in persons in the prime of life without any apparent exciting cause. In such cases I have always found it associated with a rheumatic or gouty diathesis; the disease in fact consisting in chronic thickening of the fasciæ of the palm and fingers, resulting from rheumatic inflammation of these parts. On examining the contracted fingers, projecting ridges will be felt extending from the palm to their anterior aspects; and on endeavouring to straighten them, these ridges will be found to become stretched, and the palmar fasciæ to be rendered tense. The skin covering these ridges is usually healthy, but sometimes adherent to them. So firmly are the fingers contracted, that by no effort can they be extended.

Pathology.—The pathology of this contraction has given rise to a good deal of difference of opinion amongst surgeons. Dupuytren appears to have been the first who endeavoured, by dissection, to ascertain its true character. He found, on examining a hand which was the seat of this disease, that after the removal of the skin, which was loose and flaccid, the contraction continued as before, and this, therefore, could not be its seat; but that the palmar fascia, which was exposed, was tense and diminished in size, whilst from the lower aspect some cord-like prolongations passed up by the side of the fingers; and that, when these were divided, the contraction was immediately removed, the tendons, the bones, and the joints being perfectly sound. He considered these fibrous cords to be digital prolongations of the palmar fascia, and consequently looked upon this membrane as the seat of the disease. Goyrand, who has carefully dissected hands affected in this way, states that these fibrous cords, which he looks upon as the seat of the

affection, are not prolongations of the palmar fascia, but are ligamentous structures that extend from its anterior inferior aspect to the sheaths of the flexor tendons, into which they are inserted opposite the second phalanx; being an hypertrophied condition of the subcutaneous filaments of fibro-cellular tissue which naturally exist in this situation.

Treatment.—The treatment of this deformity, when slight and recent, consists in dividing each tense digital ligamentous prolongation by a subcutaneous incision. This should be done opposite the second phalanx, where it is usually most tense; but, if the other finger-joints be affected, a separate section may be required opposite each phalanx. Should it be found to be impossible to straighten the fingers with such limited incisions, or should the skin be firmly adherent to the subjacent fibrous band, a long crucial incision may be made through the skin, this dissected back, the bands divided or dissected off the sheaths of the tendons, and the fingers straightened. As the flexor tendons are not primarily affected, they need not be divided. After the operation, the hand should be placed on a digitated splint.

REMARKABLE CONGENITAL DEFORMITY OF FINGERS.—The accompanying figures (300, 301) give an accurate representation of a remarkable congenital deformity of the hands that was under my care. In it the fingers appear to have suffered in some instances complete, in others partial, amputation *in utero*. Some were marked by deep transverse sulci, others



Fig. 300.—Left Hand.



Fig. 301.—Right Hand.

Remarkable Congenital De-
formity of Fingers.

shortened and terminating in rounded nodules, with a narrow pedicle connecting them with the proximal phalanx.

DEFORMITIES OF THE LEG AND FOOT.

KNOCK-KNEE.—The deformity termed *Genu-Valgum*, Knock or X-Knee, usually affects both extremities, though it is generally more fully developed in one than in the other. In it the knee forms the apex of a triangle, the base of which would be represented by a line drawn from the trochanter to the outer ankle. It is usually conjoined with some curvature of the bones of the leg. It is not a congenital affection, but commonly occurs in consequence of children being put upon their feet too early, the limbs thus giving way under the weight of the body. Bock states that out of 221 cases which he examined, 17 originated about the period of the first dentition; and about 200 between that age and the 15th or 18th year. Some occupations are said to predispose to it, smiths being especially liable to the disease. In it there is relaxation of the internal lateral ligament; the biceps, the external lateral ligament, and often the vastus externus, are very tense, and the patella is thrown outwards. The external condyle of the femur

will generally be found to be small, and the hollow of the ham to be obliterated.

Treatment.—The treatment consists, in the slighter cases, in applying an apparatus consisting of a well-padded iron stem along the outside of the leg and thigh; this must extend from the trochanter to the outer ankle, being fixed to a pelvic band at the upper part, and into a boot below (Fig. 302).



Fig. 302.—Apparatus for Knock-knee.

Where it corresponds to the knee it should be provided with a hinge, and should have a broad well-padded strap passing from its under side, over the inner side of the joint, and attached by buckles to the upper part of the stem, in such a way that by tightening these the knee may be drawn outwards. This apparatus should be constantly worn for many months; and, if properly adapted, may effect a cure.

When the deformity is of old standing, and the parts about the outer side of the joint very tense, the biceps tendon may require division. In doing this, care must be taken not to injure the peroneal nerve. In some cases the vastus externus and contiguous portion of the fascia lata may also be advantageously divided, and the apparatus then applied as directed.

CONTRACTION OF THE KNEE-JOINT —

Contraction of the knee-joint is one of the most distressing deformities to which the human frame is liable. If it be severe, the

leg is bent at nearly, or perhaps at quite, a right angle with the thigh. It is fixed in this position, so that the patient cannot put the sole of the foot, nor even the points of the toes, to the ground; hence the limb becomes useless for the purpose of progression, and, from want of exercise, atrophies. But a leg with a badly contracted knee is worse than useless—it is a positive incumbrance; for, as the foot cannot be brought fairly to the ground, the limb projects behind in a most awkward manner, swaying as the body moves round, constantly in the way, and liable to injury. From want of exercise, the nutrition of the limb thus affected becomes impaired: the foot is usually habitually cold, the circulation in it is languid, and the toes become liable to chilblains and troublesome ulceration.

In the less severe forms of contracted knee, the inconvenience, though not so great as that just described, is yet very considerable, for, as the patient can never bring the heel or sole to the ground, he rests insecurely on the tips of his toes, and walks but unsteadily with the aid of a crutch or stick.

Varieties.—This deformity may be of two kinds. 1. It may consist of simple flexion of the leg on the thigh, at a greater or less angle, and with more or less mobility, according to the degree of ankylosis. 2. In addition to this, there may be horizontal displacement of the bones, the head of the tibia being thrown backwards, the femur and patella remaining *in situ*, but apparently projecting more than is natural.

In examining a case of contraction of the knee-joint, the patient should be placed on his face, with the thigh extended. The leg on the affected side will then be raised more or less perpendicularly, and the amount of

contraction may be judged of by the angle that it forms with the thigh. The degree of mobility also may readily be ascertained. In this way a more correct idea of the amount of contraction can be obtained than by examining the patient whilst lying on the back, when, in consequence of the thigh being flexed on the abdomen, the extent of the angular deformity cannot be so well determined.

Causes.—Contraction of the knee-joint may arise from a great variety of pathological conditions. Some of these are altogether external to the joint, being seated in the nerves or muscles of the limb; whilst others, and the majority, consist in some morbid change that has taken place within the joint itself in its ligamentous or osseous structures. As the contraction depends on such very varied causes, the *Treatment*, having reference to the cause as well as to the actual morbid conditions, must be equally diversified.

Contraction from Nervous Irritation is usually associated with general hysteria, of which it is but a local symptom, and commonly occurs in girls and young women. In this form of contraction there is no evidence of disease within the joint; no redness, swelling, or other sign of inflammation; but there is great pain and tenderness about it. This pain, as usual in hysterical cases, is superficial and cutaneous, and radiates to some distance beyond the articulation. Any attempt at straightening the limb not only greatly increases the pain, but also calls the adjoining muscles into such forcible action that it is impossible to improve the position. These callo symptoms are connected with the ordinary signs of an hysterical temperament, with spinal irritation, and often with uterine derangement.

The *Treatment* of these cases of *hysterical contraction* of the knee is simple. The first thing to be done is to straighten the limb. This can only be effected by putting the patient under the influence of chloroform, when, all sensibility being suspended, the muscular opposition, which is partly voluntary, and no doubt in some measure reflex, is no longer called into action, and the limb falls of its own accord almost into the straight position, in which it must be retained by means of a long splint, lest the retraction recur with returning consciousness; and then, the hysterical condition being removed by treatment calculated to improve the general health, the tendency to the return of the deformity will be obviated.

We occasionally see contraction of the knee from spasmodic action of the hamstrings, produced by some irritation applied to the nerves at a distance from the part. Just as spasm of the internal rectus muscle of the eye occasions squint, so long as the irritation that gives rise to the spasm lasts; so there may be spasm of the hamstrings, with contraction of the knee as a consequence.

Most commonly, however, the joint itself is at fault, either in consequence of subacute inflammatory action within it, or of the chronic and permanent changes induced by former inflammatory attacks.

Contraction from Inflammation of the Knee.—In inflammation of the knee, the patient naturally and instinctively places the limb in the semi-flexed position, as being that in which there is least tension exercised on the structures that enter into the joint, and consequently that which is most congenial to his feelings. This position, which is immediately assumed on the occurrence of acute and active inflammation in the joint, comes on more gradually in cases of subacute inflammation; and here the symptoms of disease in the joint may be so slight that the contraction may be considered the chief ailment, and engross too exclusively the surgeon's attention.

Chronic Contraction.—The next class of cases that we have to consider are those of a more chronic and intractable kind, lasting often for years, dependent upon structural lesions of a deep and important character in and around the joint, and requiring very active surgical interference for their cure. These chronic forms of contracted knee appear to arrange themselves in three distinct varieties, being dependent—1, on Consolidation and Contraction of the Ligamentous Structures in or around the joint; 2, on Permanent Contraction of the Muscles, with or without the last-named condition; and, 3, on Osseous Ankylosis. Each of these varieties will require separate consideration, as each demands a special mode of treatment for its cure.

1. Those cases of contraction of the knee that depend on *Consolidation of the Ligamentous Structures* in and around the joint, resulting from former inflammatory attacks, are not only the most numerous, but the most readily amenable to treatment. When the structures outside the joint, such as the capsule and ligaments, are the parts chiefly affected, the inflammation has usually been of a rheumatic character. When the internal structures have been disorganised, and fibroid deposits have taken place within the joint, the inflammation has generally been strumous. In these cases the knee is usually fixed at or near a right angle, and is capable of but very limited motion; to such a degree only, in most instances, as will allow the foot to move to the extent of two or three inches. The hamstring muscles are not tense, even when the knee is extended to its utmost; and, indeed, in some cases they are flaccid, and feel soft. Not unfrequently the leg admits of extension up to a certain point, with as much freedom as in the natural state, and then the further movement of the limb is checked by a sudden stop. If this be not dependent on the tibia coming into contact with an ankylosed patella, it is owing to shortening of the crucial ligaments, or to the formation of adhesions within the joint. In this form of contraction, the knee is often much distorted, in consequence of the head of the tibia being partially dislocated backwards, or having its axis directed more or less to one side, most commonly inwards, constituting a kind of genu valgum. This distortion is, I believe, dependent on softening and consequent relaxation, either of the ligamentum patellæ or of one or other of the lateral ligaments. When the head of the tibia is displaced backwards, it will most generally be found that the ligamentum patellæ has been



Fig 303.—Contraction of Knee joint; Head of Tibia drawn backwards.

either partially absorbed, and thus weakened; or that it is elongated, the patella being drawn upwards or to one side. In either way, the action of the extensor muscles of the thigh upon the head of the tibia is weakened; and that bone, being consequently brought under the influence of the hamstrings without a counterpoise, is drawn backwards (Fig. 303). In those cases in which there is lateral rotation of the tibia, the faulty position may have arisen from the attitude

that the limb has been allowed to assume during the progress of the disease in the joint.

In the *Treatment* of this form of contraction of the knee, simple extension of the limb will often prove sufficient. This may either be done gradually by means of the screw-splint behind the knee, or forcibly and at once under the influence of chloroform. I prefer the latter method, not only as being the speediest, but as being perfectly safe and effectual. The mode of effecting forcible extension is as follows. The patient being fully under the influence of chloroform, and lying on his face, the surgeon, standing above him, seizes the foot of the affected limb with one hand, whilst with the other he steadies the limb just above the knee. He now extends the leg gradually but forcibly; as it comes forwards, the bands of adhesion in and around the joint will be felt and heard to give way with loud snaps and cracks, distinctly audible at some distance. Should there be much resistance within the joint, the surgeon may apply his own knee or elbow to the upper surface, and thus increase the force with which the limb is acted upon. In this way I have never found any contractions of the kind now under consideration able to resist the surgeon's efforts, nor any difficulty in effecting at once the extension of the limb. Nor have I ever seen any evil consequences result; indeed, it is surprising to what an amount of force a joint that has been contracted for any length of time may be subjected without inconvenience. In these cases it would appear as if the synovial membrane lost its susceptibility to inflame, just as is the case with serous membranes that have been the seat of chronic inflammation and its consequences. Beyond some pain for a few days, and slight heat, easily subdued by cold evaporating lotions, I have never seen any ill results arise; but then care must be taken that no inflammatory action is going on within the joint at the time of this manipulation, as, if such action were present, the operation would certainly be followed by injurious results. After the extension has been made, the limb should be fixed on a long splint, well padded, some evaporating lotions applied, and the patient kept in bed for a few days, when, with the aid of a starched bandage, he may walk about.

After extension has been effected, the position of the head of the tibia backwards may still occasion considerable deformity and weakness of the limb (Fig. 304). This condition is best removed by the use of the instrument of which the sketch on next page (Fig. 305) is a good representation; it was designed and constructed by that excellent surgical mechanic, Mr. Bigg. The diagram (Fig. 304) represents a limb with the tibia displaced backwards, the angular contraction having been remedied. In the centres of the end of the thigh-bone and of the head of the tibia, two letters (X and Z) are placed to designate the axis of each bony head, beneath and above which the displaced joint has formed its abnormal axis. The dotted lines represent the leverage formed by the cylindrical surface of the tibia and thigh-bone. The arrows are placed in such a direction as the bones would take in resuming their normal position. It will readily be seen that any instrument capable of acting in the mechanical directions shown by the arrows, would accomplish not only the restoration of the joint, but extend, if contracted, the extremities of both femur and tibia.

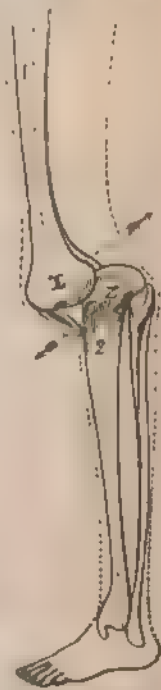


Fig. 304 — Knee-joint after Extension. Head of Tibia thrown backwards.

An additional advantage that this instrument possesses over any other with which I am acquainted, is the application of spring-power, by means of which flexion of the knee becomes an element towards the restoration of its utility.

Instead of muscular action being arrested, and atrophy of the limb being thus produced, movement is conducive to the perfect action of the apparatus; so that the patient experiences but little inconvenience from its use, all the ordinary positions assumed by the knee in walking, sitting, or standing, being preserved.

By this form of apparatus, then, three important points are secured, viz., replacement of the head of the tibia, extension of the angle of the leg, and free muscular action during the period of treatment.

In Fig. 305, A and B are two levers, composed of metal, corresponding in their direction to the perpendicular position of the thigh-bone and tibia. C and D are two axes, placed exactly coincident with the centres of the articular ends of the bones. E and F are two powerful springs, acting in opposing directions; viz., in those indicated by the arrows in Fig. 304. Thus F presses the lever B in an anterior direction, bearing the end of the tibia forward, whilst E presses the lever A in a posterior direction, bearing the end of the thigh-bone backward. As C and D are found acting above and below the actual axis of the knee-joint, they mutually influence the point formed by the apposition of the heads of the tibia and thigh-bone; and as it has already been explained that the thigh-bone really offers a fixed resistance, and the tibia

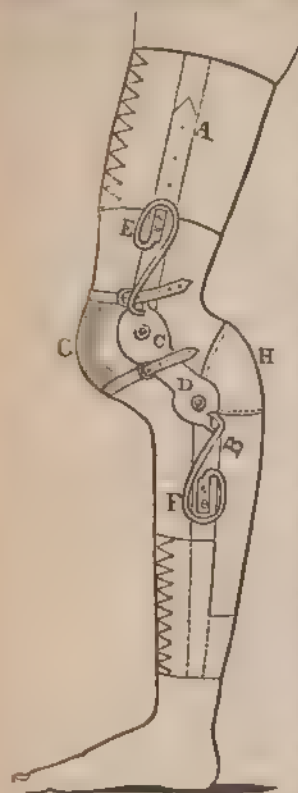


Fig. 305.—Apparatus for restoring Position after Extension of Contracted Knee-joint.

moves beneath it, the head of the latter bone is turned anteriorly in a semicircular direction consequent on the upper centre (C) being a fixed point, and the lower centre (D) rotating around it. G is an elastic knee-cap; H, a padded plate. When the ligaments are tense, there is a chance of pressing the anterior surface of the tibia against the posterior surface of the thigh-bone. This is readily obviated by having the shaft (A) made to elongate, when the centre (C), being a little lowered, pushes the lever (B) downwards, carrying the tibia with it, and thus separating the osseous surfaces of the joint.

2. The next class of cases of contracted knee that we have to consider are those in which the *Hamstrings are Contracted*, either alone or in addition to those results of chronic inflammatory action within the joint that have just been described. In these cases the hamstrings will be found to be tight; and, in proportion as the leg is extended on the thigh, they will become more tense, until at last all further extension is resisted, apparently by their traction, and not by any sudden check or stop within the joint itself.

Division of the Hamstring Tendons is in ordinary cases as simple an opera-

as any in surgery, unattended by any difficulty, provided the surgeon introduce the tenotome parallel and close to the side of the tendon to be divided, and cut in a direction from the inside or popliteal aspect towards the outside. The outer hamstring will usually be found to be the most tense, and should first be divided. In doing this, the peroneal nerve might appear to be in danger; but this may be avoided by keeping the side of the tenotome well against the inner edge of the biceps tendon, then turning the edge outwards, when passed deeply enough. The semitendinosus requires division next. The semimembranosus need not often be cut across. After the division of the tendons, tense aponeurotic bands will not unfrequently be found to stretch along one or both sides, or perhaps down the centre of the popliteal space. This may lead to the idea on the part of the surgeon that he has cut fairly cut the tendons across; but this is an error. The bands alluded to are condensed sharp-edged prolongations of the fascia lata, formed during the period of contraction of the joint by the retraction and thickening of this membranous expansion. Such condensations as these had better be left untouched, as they will readily stretch out under gradual extension, or be ruptured by forcible traction of the limb. If, on the other hand, the surgeon be tempted by their apparently superficial and safe position to proceed to their division, he may be led into a serious dilemma by being brought more readily into contact with the popliteal vessels than is desirable or safe. In these cases, the anatomical relations of parts are so much altered by the narrowing of the popliteal space, and by the projection of the head of the tibia backwards or by its lateral rotation, that the surgeon is unable to calculate with sufficient nicety the precise position of the large vessels and nerves in the neighbourhood of which he is about to act; and he may thus injure one or other of these at a time when he thinks that he is operating at a safe distance from them.

After the division of the hamstrings, the knee does not commonly come readily into the straight position, but gradual extension, by means of proper apparatus, will be required to break through or extend the adhesions within and around the joint.

Contraction with Lateral Displacement is not unfrequently met with. In these cases the knee is contracted more or less in the angular direction; but, in addition to this, the lower end of the thigh-bone is directed inwards and perhaps somewhat forwards, and the tibia is rotated outwards, carrying the foot with it. There is thus a triple deformity—angular, mesial, and rotatory. I believe the angular to be the primary deformity, and the mesial and rotatory to be secondary to this, arising partly from the efforts of the patient to walk by resting on the point of the great toe, and throwing the thigh inwards in order to effect this, and partly from the action of the biceps rotating the leg inwards.

The *Treatment* of these cases is not very satisfactory. Mere extension of the limb, whether gradual or forced, may counteract the angular deformity; but it will not only leave the other displacements ununinfluenced, but may actually increase the rotation of the leg outwards. A leg and thigh-splint, such as in Fig. 305, but having, instead of the springs, a rack and-pinion apparatus working on three centres, so as to extend the limb, abduct the knee, and rotate the leg inwards, is the only contrivance by which this deformity can be counteracted, and the limb properly restored to shape.

3. *Ossous Ankylosis of the Knee* is not of very frequent occurrence. It is usually, if not invariably, the result of traumatic inflammation of the joint. If the limb be straight no operation will be advisable; if it be bent, we

that the patient cannot put the foot to the ground, the only remedy will be the operation practised by Dr. Rhea Barton, of sawing out a wedge-shaped portion of the ankylosed bones, and then bringing the limb into the straight position. Judged by the excellent results that have followed resections of the knee-joint, such an operation is not unlikely to be attended by good success. Should there be much atrophy of the limb, with shortening of it, and possibly necrosed bone with old sinuses and occasional abscesses about the knee, amputation will place the patient in the position of most comfort.

Ankylosis of the knee in the *straight position* interferes comparatively little with the utility of the limb. It is, however, desirable, when practicable, to restore the flexibility of the joint. The possibility of doing this will depend on the degree of ankylosis. If this be osseous, or even if densely fibrous, little can be done; but if the rigidity depend chiefly on condensation of the capsule, and the deposit of plastic matter externally to the joint, much may be effected by passive motion, shampooing, douches, and friction.

Ankylosis of the knee in the *angular position forwards*, so that the leg is bent upwards upon the thigh, is of very rare occurrence. Indeed, I am acquainted with only two preparations illustrating this deformity—one in the museum of St. Thomas's Hospital, another exhibited by Mr. Adams to the Pathological Society, from a limb amputated by Dr. Grant of Canada, in which this condition occurred in a young man as the consequence of a wound of the joint some years previously.

CLUB-FOOT.—Deformities of the feet are commonly single; but not unfrequently they affect both extremities. They appear to be more frequent in boys than in girls. Four varieties of club-foot are recognised:—*Talipes Equinus*, in which the heel is elevated; *Talipes Calcaneus*, in which the anterior part of the foot is drawn up; *Talipes Varus*, in which the foot is twisted inwards; and *Talipes Valgus*, in which it is twisted outwards. These conditions may occur in the simple forms just mentioned; but most commonly talipes varus is complicated with equinus, and not unfrequently talipes valgus with calcaneus. Bonnet, of Lyons, has made a classification of talipes, according as it is occasioned by an affection of the internal or of the external popliteal nerve. When the muscles supplied by the internal popliteal are affected, we find the talipes equinus, equino-varus, and varus. When the external popliteal is affected, we have the calcaneus and valgus.

Pathological Changes.—On dissecting a foot affected by talipes, it will be seen that but little alteration has taken place in the condition of the bones. In some preparations of this kind which are in the University College Museum, these are nearly in a normal condition (Figs. 306—309). Indeed, in talipes equinus and calcaneus, they are scarcely if at all altered; but in talipes varus and valgus, if of old standing, the astragalus will generally be found atrophied, more particularly about its head, which may be somewhat twisted, and the scaphoid and cuboid bones will be seen to have undergone similar changes. The ligaments are necessarily somewhat altered in shape, being lengthened on the convexity, and shortened on the concavity of the foot, the direction of the tendons is altered, and the muscles, not only of the foot, but of the leg and thigh, are generally atrophied from disuse, so that the limb in old cases is withered and shortened; indeed, so great an incumbrance may it occasionally become under these circumstances, that amputation of the leg may be insisted on by the patient, and may with propriety be performed by the surgeon.

Talipes Equinus is characterised by elevation of the heel, and great tension of the tendo Achillis, so that the foot is extended in nearly a straight line with the leg, and the patient walks on his toes, which are placed at a right angle to the foot (Figs. 306, 307). In this deformity there is



Fig. 306.—*Talipes Equinus*.

no lateral displacement. According to Tamplin, it is never congenital. It most commonly arises from disturbance of the nervous system, during teething, or from the irritation of worms in children. In adults, as well as in children, it may come on from some disease, such as abscess in the calf of the leg, by which the gastrocnemius muscle is crippled. It is the most important, and at the same time the simplest in itself, of all the forms of club-foot; it commonly compli-

cates the other species.

The Treatment consists in dividing the tendo Achillis, and bringing the heel well down.

The tendo Achillis is best divided about an inch above its insertion into the os calcis. The patient should be laid prone; the surgeon, grasping the foot, extends it forcibly, so as to throw out the tendon in good relief, and make it tense; he then slides a tenotome beneath it, and cuts slowly through it from beneath upwards, bearing well upon the foot; as the division proceeds, he will hear the tendon cracking as its fibres are successively cut through. The division should never be made from above downwards, as the posterior tibial artery or its malleolar branches might readily be wounded.

Talipes Calcaneus is an extremely rare variety of club-foot. In it the heel is depressed, the toes and anterior part of the foot being elevated (Fig. 308); it is usually, I believe, congenital—in one case, however, that of a girl twelve years of age, it was acquired. It arises from contraction of the extensor tendons.

Treatment.—In order to bring down the foot, the tibialis anticus, the extensor communis, the extensor pollicis, and the peroneus tertius muscles, may all require to be divided as they pass over the dorsum; a straight splint should then be applied, and the foot drawn down to it. A minor degree of this affection consists in a peculiar pro-



Fig. 308.—*Talipes Calcaneus*.

jection upwards of one or two of the toes, associated with some tension of the extensor tendon: by dividing this, and keeping the foot on a flat splint, the deformity may commonly be corrected. In some cases, how-



Fig. 307.—Bones in *Talipes Equinus*.

ever, the toe is so prominent, and the contiguous ones are squeezed under it in such a manner, that the foot is completely crippled, and amputation of the displaced digit is required in order to restore the utility of the member.

Talipes Varus.—In this deformity the foot is twisted inwards, and the



Fig. 309 —Talipes Varus.

sole is contracted ; the patient walking on the outer side of the foot, where the skin covering the tarsal end of the fifth metatarsal bone often becomes excessively dense and firm, and a bursa occasionally forms (Figs. 309, 310). In most cases there is some elevation of the heel, the affection partaking somewhat of the cha-



Fig. 310 —Bones in Talipes Varus.

acter of talipes equinus. It is the most common form of congenital deformity, both feet being found similarly affected ; but it may be non-congenital, and then it is limited to one foot.

The *Treatment* consists in the successive division of the tendons of the tibialis anticus and tibialis posticus, which are the muscles principally at fault. After these have been cut across, the tendo Achillis should be divided ; but its section should be made last, as it steadies the foot, and thus facilitates the division of the tibial tendons. In most cases the plantar fascia is contracted, and requires division wherever it feels tense and projecting. In the section of the tibialis posticus tendon behind the ankle, there is much danger of wounding the posterior tibial artery, which lies close to it. The best way to avoid this vessel is, as Tamplin recommends, to puncture the sheath of the tendon with a sharp scalpel introduced directly downwards, and then to divide it in a direction forwards, away from the vessel, with a blunt tenotome. There will also be less risk of this accident occurring, if the line of the tibia be clearly felt and taken as the guide for puncturing the fascia over the tendon. Unless great care be taken in cutting through the tendo Achillis, there is also some risk of wounding the artery ; as, in bad cases of varus, these two structures lie nearly parallel to one another, the tendo Achillis being drawn out of the median line towards the inner ankle. Indeed, in one instance I have seen the posterior tibial artery punctured during the division of this tendon, or rather in an attempt to divide some tense bands that lay beneath it ; the bleeding, which was very free and in a full jet, was, however, readily stopped by pressure, no bad consequences resulting. The proper plan of treatment, when such an accident occurs, is, when the artery is merely punctured, to cut it completely across, and then to apply firm pressure, by means of a pad and bandage, over the bleeding orifice. Tamplin states that he has seen no ill effects follow this accident. If a circumscribed false aneurism form, it must be laid open, the clots turned out, and the vessel tied. No extension of the foot should be practised for some time in such cases, lest the coagulum be disturbed.

In ordinary cases of varus, after a lapse of four or five days, Scarpa's or Little's shoe, or Aveling's talivet, may be applied ; or the foot may be well

abducted by means of a wooden splint, fixed to the outer side of the leg, and provided with pegs, so placed that the toes can be drawn up, and the foot well turned out, by rollers and tapes attached to them.

Talipes Valpus—*Flat or Splay Foot*—is the antithesis to varus. In it there is a tendency in the first instance to obliteration of the arch of the instep, so that the sole becomes perfectly flattened; and, as the disease advances, a tendency to eversion of the foot usually takes place (Fig. 311).

When it has advanced to this extent, the toes and anterior part are often somewhat raised, so as to constitute the variety termed *Calcaneo-valgus*. In *talipes valgus* the ligaments of the sole of the foot, which bind the bones together so as to form the arch, are weakened and elongated, and the peroneal and extensor tendons are commonly tense. It is not so frequent a form of club-foot as the other varieties. It commonly affects only one extremity, being often met with in young adults, as the consequence of over-fatigue of the foot from long continued standing and from the habit of sliding the foot in walking, or twisting it, so as to press upon the inner side. When both feet are everted, there is usually knock-knee as well; and then this affection is met with at a much earlier period of life.



Fig. 311.—*Talipes valgus*.

Treatment.—In the earlier stages of acquired *talipes valgus* in young adults, more particularly in young women, the deformity may often be remedied by putting the patient under the influence of chloroform, forcibly drawing the foot inwards, so as to overcome the tension of the peronei muscles, fixing it in a Dupuytren's splint, and afterwards restoring the arch of the foot by a convex sole in the shoe.

In the more confirmed cases, the treatment consists in the division of the tendons of the peroneus longus and brevis, behind the outer ankle; and of that of the extensor communis on the dorsum. Scarpa's shoe may then be applied, and the arch of the foot restored by wearing a pad under the sole for some considerable time.

In *Talipes Calcaneo-valgus* the projection of the heel backwards is obliterated, and the outer side of the foot curved round towards this, so that the little toe approaches the point of the heel. It is not a congenital affection; and, as it commonly arises from a partially paralysed state of the gastrocnemius, the treatment is not very satisfactory.

CONTRACTION OF THE PLANTAR FASCIA.—In some cases, great arching of the instep and shortening of the foot will result from contraction of the plantar fascia. Here the division of the internal and middle prolongations of this structure will be necessary; after which, a Scarpa's shoe with a jointed foot piece may be used, to effect extension of the arch of the foot.

CONTRACTION OF ONE TOE is not of unfrequent occurrence. In this complaint the proximal phalanx is either on its normal level or slightly drawn up; the two distal are bent down at an acute angle, the apex of which is formed by the articulation of the first with the second. This contraction more commonly affects the second toe, is often asymmetrical in the two feet, and is frequently a source of great inconvenience, and even permanent lameness. It appears to be due to contraction of the digital prolongation of the plantar fascia, and is best remedied by dividing this subcutaneously opposite the lower part of the second phalanx, and then straightening the toe.

WEAK ANKLES not uncommonly occur in rickety children : the ligaments being relaxed, the joints appearing to be swollen, and the child being unable to walk or stand without great difficulty. Under these circumstances, attention to the state of the general health, douching with salt water, with the application of an elastic India-rubber bandage round the ankle, or the use of light iron supports, will be found most useful.

DISEASES OF REGIONS.

CHAPTER LV.

DISEASES OF THE HEAD AND NECK.

DISEASES OF THE SCALP AND SKULL.

FUNGUS OF THE DURA MATER.—Sometimes without external or apparent cause, at other times in consequence of a blow or fall, a *Fungous Tumour* grows from some part of the dura mater, usually on the top of the head or one of the parietal regions. As it increases in size, it produces absorption of the skull covering it, the bone becomes thinned and expanded, and crackles like parchment on pressure, sometimes not being raised above its proper level, but more usually being pushed up by the pressure of the growth beneath, which at last protrudes under the scalp. More usually, this perforation of the skull is gradual ; but in some cases it would appear to have been sudden, the first intimation that the patient had of disease being the presence of a tumour under the scalp. When the skull is perforated, the sharp edges of the circular opening can be distinctly felt ; and the tumour which protrudes pulsates distinctly, as may be proved both by the finger and by the eye.

Symptoms.—Symptoms of cerebral disturbance—double vision, loss of sight, deafness, or epileptic fits, with fixed pain in the head—usually precede for a considerable time the external appearance of the tumour. In some rare cases, no such symptoms have indicated the existence of intracranial disease ; and the first evidence of the disease has been the sudden protrusion of a pulsating tumour through the skull. If the tumour be compressed, egg shell crackling of the expanded and thinned cranial bones will be felt, and, if attempts be made to push it back under the bones, giddiness, syncope, and convulsions are produced. As the disease makes progress, death from paralysis and coma supervenes.

Treatment.—The result of the treatment of fungus of the dura mater is not very satisfactory ; yet, as the disease appears to be almost of necessity fatal if left to itself, something should be attempted—not, however, until the tumour has fairly appeared through the bones. The scalp covering it should be turned back by a crucial incision, and the tumour exposed. The aperture in the skull through which it is protruded may then, if necessary,

be enlarged by the use of the trephine or Hey's saw, so as to lay bare the full extent of the tumour, which must then be carefully dissected away from the dura mater.

FUNGUS OF THE SKULL may occur. At first it closely resembles the disease just described; it differs from this, however, in being devoid of pulsation, and incapable of being pushed back. It appears to spring from the diploe of the skull, and may probably be of a myeloid or encephaloid character, sometimes secondary to primary deposits of a like nature elsewhere. In other cases it appears to be simply vascular, in structure resembling the pulp of a red gooseberry or a broken-down mulberry. In a case of this kind which I had an opportunity of seeing some years ago, the growth was successfully removed by Mr. B. Phillips.

HERNIA CEREBRI, arising from wound or ulceration of the dura mater, has been already described (p. 356).

ENCEPHALOCELE, or CONGENITAL HERNIA OF THE BRAIN, is a rare malformation, usually speedily fatal. Mr. Z. Lawrence finds that, of 39 instances in which it occurred, 21 were males, 18 females; that the protrusion may vary from the size of a pea to that of a tumour exceeding the child's head; that the occiput is its chief seat,—of 79 cases, 53 being in this situation. In 6 instances, the subjects of this malformation reached an adult age; in all the remaining cases they died early, or were still born. Surgery offers little in these cases; though in one instance the protruding portion of brain was successfully sliced off, the patient surviving.

DISEASES OF THE EYE AND ITS APPENDAGES.

ENCYSTED TUMOURS OF THE EYELIDS.—Small cysts are not infrequently met with, lying between the tarsal cartilage and the conjunctiva. At first they occasion no inconvenience; but as they increase in size they cause the conjunctiva covering them to become injected, papillated, and granular, thus at last occasioning a considerable amount of irritation and lachrymation.

Treatment.—These tumours may be removed either by being dissected out, or by being obliterated by inflammation set up in them. When the tumour is to be dissected out, the eyelid must be everted, and the cyst, having been exposed by dividing the conjunctiva covering it with a fine scalpel, must be drawn forwards with a hook and removed by a few touches of the knife. This little operation is, however, at times somewhat troublesome; and in preference to it I always induce obliteration of the cyst by exciting inflammation in it. This may most conveniently be done by everting the lid, and then making a crucial puncture into the cyst with a lancet; the contents having escaped or been squeezed out, and the part well dried with a piece of lint, a pointed silver probe dipped in nitric acid should be quickly introduced through the puncture, and the inside of the cyst stirred up; and, a little sweet oil having been poured over the lid, it may be replaced. Some induration will be left in the site of the cyst for a few weeks; but, as that subsides, the tumour will be found to have disappeared.

Not unfrequently larger cysts, varying in size from a cherry to a plum stone, are met with at the outer angle of the eyebrow, extending to the eyelid or the temple. These may contain either clear fluid or atheroma, and are readily extirpated by a linear incision parallel to the fibres of the orbicularis palpebrarum.

PUNCTURE OF THE LACHRYMAL SAC.—This operation is frequently required in those cases in which, the nasal duct having become obstructed, the lachrymal sac becomes distended by the accumulation of the tears, inflames, and either threatens suppuration, or gives way so as to leave a fistulous opening

below the inner angle of the eye, through which tears often escape—the ordinary *fistula lachrymalis*. If a fistula have not already formed, the sac being merely distended, the passage through the nasal duct may sometimes be restored by the careful introduction of a very fine silver probe into it through the puncta; or the sac may be injected through the same orifice by means of one of Anel's syringes. Should these measures not prove successful, the permeability of the duct may be restored by catheterism from below; for this purpose a steel probe or sound, bent nearly to a right angle at about one inch from the extremity, should be passed into the nostril beneath the inferior turbinate bone; by a slight to-and-fro movement, the point of the instrument may be made to enter the orifice of the duct, and then, on directing the handle downwards and inwards, it will pass up along the canal into the lachrymal sac.

If these means, however, do not prove successful in restoring a passage for the tears, or should a fistula have formed, the sac may be punctured and a style passed into it from above. This operation may be performed in the following way. The patient's head being well supported on the breast of an assistant, and the lower eyelid having been put well on the stretch by traction with the finger at the outer angle, the surgeon feels for the tendo oculi, the under surface of which is the guide into the lachrymal sac. In many cases, however, owing to the swelling and induration of parts, this tendon cannot be felt; and then the guide must be the edge of the orbit below and a little to the outside of the puncture. Having ascertained this, he rests the little finger on the cheek; and, holding a strong narrow-bladed bistoury between the forefinger and thumb, with the flat of the blade parallel to the face and the edge turned outwards, he passes the point downwards and inwards well under the tendon of the orbicularis, the handle resting against the middle or outer third of the eyebrow (Fig. 312). He then, by



Fig. 312—Puncture of the Lachrymal Sac.

carrying the handle inwards and somewhat forwards until it rests against the bridge of the nose, causes the point to take a direction backwards, downwards, and slightly inwards, for about three-quarters of an inch, when the nasal duct will be fairly entered, which may be known by the bistoury supporting itself. The style may then be introduced along the blade, which should be firmly pressed inwards.

In order to avoid the puncture of the sac and the introduction of styles in the ordinary way, Bowman has introduced a new method of treatment in cases of stricture or chronic inflammation in the lachrymal canals or sac. It consists in passing a fine probe into one or both puncta—usually the lower one is sufficient; then slitting this up on its conjunctival aspect with a narrow-bladed knife, so as to open the canaliculus freely; down this a probe is then carefully passed, the stricture, if any exist, dilated or incised, and the nasal duct opened.

The performance of these operations must be accompanied by the adoption of proper local and constitutional treatment.

EXTIRPATION OF THE LACHRYMAL GLAND may be required for cancerous degeneration. This operation may be performed from the outer or from the inner side of the lid: whenever practicable, it should be done from the inner aspect. It is performed in the following way. The outer commissure of the lids having been divided as far as the edge of the orbit, the upper eyelid is everted by an assistant; the surgeon then divides the conjunctiva covering the tumour, and, fixing a hook in it, draws it forwards, and with a few careful touches of the knife divides its attachments. After the removal of the tumour the lid drops into its normal position, and the commissure is closed by a suture.

EXTIRPATION OF THE EYEBALL.—This operation may be required for cancer of the eyeball, either of an encephaloid or a melanotic character, as represented in the following drawing (Fig. 313), taken from a patient of mine affected with subconjunctival melanosis of the eye. It is also occasionally called for when, in consequence of injury or disease, one eye has become disorganised and the vision of the other is sympathetically affected, and can only be preserved by the removal of the globe that is already useless. The operation may be performed in the following way.



Fig. 313.—Melanosis of the Eye.

The surgeon, standing in front of the patient, who is recumbent, makes an incision through the outer commissure of the lids as far as the edge of the orbit. The eyelids are then well everted, and held apart by a wire speculum. The surgeon next passes a double hook into the globe and draws it well forward; then with a curved broad pair of scissors he divides the conjunctiva at its upper part, and proceeds to cut across the several muscles of the orbit, and lastly the optic nerve. Should any of the structures within the orbit now present an unhealthy or suspicious appearance, he clears them out. The hemorrhage, which is usually rather abundant, may be readily arrested by a pledget of dry lint, pressed into the orbit and retained by means of a circular bandage.

If the lachrymal gland be diseased, it must of course be removed with the eyeball. If sound, it may be left, as it atrophies and gives no trouble.

DISEASES OF THE EAR.

INFLAMMATION OF THE EXTERNAL EAR, OTITIS, or EAR-ACHE, is usually a rheumatic affection, and is characterised by intense pain, generally associated with hemicrania; a kind of combination, indeed, of inflammation and neuralgia. This pain is much increased at night, by warmth of the bed, and is generally accompanied by throbbing and noises in the ear. The *Treatment*, at first antiphlogistic, generally and locally, may advantageously, after a time, give place to quinine and iodide of potassium, with the external application of aconite. Occasionally the affection runs on to the formation of abscess in the meatus externus, attended by excessively painful throbbing. To relieve this, leeching, poulticing, and early lancing will be required.

OTORRHEA.—This is a fetid discharge of a muco-purulent character, usually occurring in strumous children, and often associated with enlarged glands under the angle of the jaw. It may be of two kinds; either proceeding simply from the mucous surfaces, and being inflammatory; or being connected with necrosis of the petrous portion of temporal bone, associated with disease and destruction of the tympanum, and necessarily of the internal

ear. In the first case, astrigent injections containing some of the chlorides in solution may advantageously be used, and will commonly arrest it. If, however, it proceed from disease of the bones, it is necessarily of a far more serious character; and, the membranes at the base of the brain becoming irritated by the extension of the morbid action to them, convulsions and death usually at last result. In some of these cases, phlebitis of the sinuses and of the cerebral veins ensues, and proves fatal.

EXTERNAL EAR.—The external ear is occasionally the seat of special affections; thus in idiots, *Hypertrophy* of this structure is sometimes met with; and in gouty subjects, *Tophi*, or *Gouty Concretions*, are occasionally deposited in it. Paget, Bruck, and Vanzetti have described a *Fibrous Tumour* that occasionally forms in the lobule of the ear from the irritation produced by piercing it, and as "one of the penalties attached to the barbarism of ear-rings." These tumours are semi-malignant, like the warty growths of cicatrices; and, after excision—their only treatment—are somewhat apt to return.

CONCRETIONS IN THE MEATUS.—We not uncommonly find that the meatus becomes blocked up by accumulations of wax, dark, indurated, and pipe-like, or forming balls and masses that lie in contact with the tympanum. These chiefly occur in individuals of the bilious-phlegmatic temperament, and are a common source of temporary deafness among young people. They not only materially impair the sense of hearing, but are very apt to give rise to noises in the head, and to crackling sensations on opening and shutting the mouth. Their presence is best ascertained by examination with a well-constructed ear-speculum; that introduced by Toynbee, of a double convex shape, is the most useful. The *Treatment* of these concretions consists in softening the wax by the introduction of a little glycerine into the ear for a few nights, and then repeatedly washing out the meatus by the injection of tepid soap and water, or water containing a little soap-liniment, thrown in with a large syringe; as the fluid regurgitates from the tympanum, it will at length bring away the dark and hardened ceruminous masses.

POLYPI are occasionally met with, situated rather deeply on one side of the meatus. They are usually hard and fleshy-looking, though sometimes soft and gelatinous, as in the nose; sometimes pediculated, but at others situated on a broad base. They produce serious inconvenience by obstructing the external ear, and require to be pulled off by means of forceps, or, if too firmly fixed for this, cut off with scissors; the surface from which they spring should then be touched with nitrate of silver, so as to prevent a recurrence of the growth.

THICKENING OF THE CUTICLE.—Occasionally the cuticle of the external ear, and that covering the tympanum, becomes thickened and indurated, assuming a dull white appearance: this condition may give rise to some amount of deafness. In these circumstances, glycerine, citrine ointment, or solution of nitrate of silver, will be extremely useful in restoring the healthy action of the integument of the part.

DEAFNESS.—It is not my intention to enter into the general pathology of the various kinds of deafness, nor to discuss its causes. It may be stated generally, however, that it may arise from obstruction of the external ear from disease, ulceration and perforation of the tympanum; from various inflammatory affections, chiefly of a subacute and chronic character, of the internal and middle ear; from paralysis of the acoustic nerve, either local or dependent on cerebral lesions; and lastly, from obstruction in the Eustachian tube, or from disease of the throat. Toynbee has especially shown that many cases of so-called "nervous" deafness, together with ringing, ringing, boiling and other noises in the head, are in reality dependent upon

chronic inflammatory affections of the internal and middle ear; and that the treatment best adapted for their cure consists in constitutional and local means of an alterative and antiphlogistic character.

DISEASES OF THE NOSE AND CHEEKS.

EPISTAXIS, or bleeding from the nose, is very common in children and in young people about the age of puberty, more particularly in girls, antecedently to the menstrual period; it may either be of an active or passive character, but is most usually dependent on congestion of the mucous membrane. But in the adult it is more serious, and it may then be associated with and dependent on two very opposite conditions—either on a state of plethora with tendency to cerebral congestion, or on an anæmic and cachectic state, in which the blood is thin, and does not coagulate readily. In the first condition, when occurring in the young and plethoric, the epistaxis is often a salutary relief to the system. But when occurring in cachectic and anæmic people, more particularly in persons advanced in years, it becomes of very serious moment; and in such circumstances the loss of blood may be so continuous and copious that, unless active means be adopted, a fatal termination may ensue, the hemorrhage being truly arterial. The most dangerous forms of epistaxis do not occur in the young and plethoric, but rather in middle-aged or elderly people of feeble constitutions.

Treatment.—In young people, otherwise healthy, and in the slighter cases, epistaxis may commonly be arrested by the employment of ordinary domestic means, such as the application of cold to the nape of the neck and forehead; and its return may be prevented by the use of purgatives or attention to the proper regulation of the menstrual function.

In plethoric adults the flow should not be too suddenly checked. Should it prove very abundant, dry cupping between the shoulders, and the application of an ice-bag to the forehead, with rest, will be required.

In anæmic and cachectic subjects, and in old people, the hemorrhage is often attended by dangerous consequences, and requires the use of active measures for its suppression. In these cases the following plan should be adopted. The head should be raised, an ice-bag applied to the forehead, complete rest and quietude enjoined, and gallic acid in ten-grain doses, or half-drachm doses of the tincture of ergot, administered at frequent intervals. Should the bleeding still be profuse and continuous, the interior of the nose may be spunged out with a solution of perchloride of iron or tannin. If this do not suffice, it will become necessary to plug one or both nostrils. This is best done by means of a plug of prepared sponge, having a quill or a piece of gum catheter passed through it for breathing purposes, and soaked in a solution of perchloride of iron.

Should, however, the hemorrhage still continue, the blood forcing its way backwards into the throat, or perhaps being swallowed, the posterior nares require to be plugged as well. This is best done by carrying a long piece of strong whip-cord along the floor of the nose through the posterior nares into the pharynx, by means of Bellocq's sound (Fig. 314), or, if this be not at hand, by threading the cord through an elastic catheter, and carrying this into the pharynx, then seizing the cord as it appears behind the soft palate, and drawing it forwards into the mouth, at the same time that the catheter is taken out of the nostril. In this way the string will pass through the nose, round the back of the soft palate, into and then out of the mouth (Fig. 315). To the centre of the piece of string that hangs out between the lips, a plug of lint, of about the size of the thumb, or better still, a piece of

compressed sponge, should be firmly tied; this is then drawn up into the posterior nares by pulling on the end of the ligature that hangs from the



Fig. 314.—Bellucq's Snare.



Fig. 315.—Plugging the Nares.

nose, being guided in its passage behind the palate by the fingers introduced into the mouth. When the bleeding has ceased, it may readily be withdrawn by means of the string that hangs out of the mouth. As the epistaxis is very apt to recur, it is a wise precaution when the plug is removed from behind the palate to leave a loop of string in the nose and mouth, which may be knotted and fixed by a slip of plaster behind the ear. In this way the plug may, if occasion occur, be readily replaced without the necessity of re-introducing the sound or catheter through the nose, which is often a troublesome operation.

CHRONIC THICKENING OF THE SCHNEIDERIAN MEMBRANE.—The mucous membrane of the nose is not unfrequently chronically inflamed, especially in strumous children; that portion of the membrane covering the turbinate bones becoming thick, soft, and vascular, and projecting like a broad fringe from their surface. It is usually of a bright red colour, and covered with mucus. This swelling at all times produces snuffling and a peculiar intonation of voice, but increases in wet weather, and then may become so great as seriously to obstruct the breathing.

The *Treatment* consists in attention to the general health; more especially to the eradication of the strumous diathesis. Much benefit may also be derived from the local application or injection of astringents, as a strong solution of the nitrate of silver applied by means of a camel's hair brush, and sulphate of zinc and oak-bark lotions snuffed up, or injected by means of a proper syringe. In many instances, when this disease occurs in strumous children, change of air will effect the greatest amount of benefit.

ABSCESS occasionally forms either on the mucous membrane or on the septum, and thus may lead to necrosis of the cartilages and bones, separation of these, flattening of the nose, depression of its bridge, and great deformity. These various forms of abscess, followed by necrosis, are commonly syphilitic, and then are associated with ulcers and a foul and fetid discharge, which has a tendency to cake upon their surface, forming dark and ragged crusts, and constituting the different kinds of *Ozena*. The septum may be the seat of chronic ulcerations consequent upon the irritation of decayed

path, producing disease of the antrum, and escape of morbid secretion from the into the cavity of the nose.

The *Treatment* of these conditions must be conducted by the local application of nitrate of silver, black wash, and the chlorinated lotions; the general treatment consists usually in the administration of the dilute mineral acids, iodide of potassium, and sarsaparilla.

ULCERS and FISTULES, of a less serious character, though very painful and chronic, often occur at the angle of the ala and septum, or between the ala and tip. Their *Treatment* consists in touching them from time to time with nitrate of silver, or in the application every night of white precipitate or strychnine ointment; at the same time that the general health is attended to, cachexy removed, and the strength restored, by the administration of iron, bark, and sarsaparilla.

NECROSIS not unfrequently occurs in the loose bony structures lying in the nasal fossæ or in the nasal bones themselves. In these cases the septum nasi participates in the morbid action, and commonly separates or is perforated.

Necrosis may occur in these situations either as the result of syphilis, the action of mercury, or from external injury. I have, however, seen cases, more particularly in women and children, which were not referrible to any of these causes, or indeed to any other external exciting cause, and in which scrofula was probably the occasion of the disease.

The presence of the necrosis may be suspected from the great fetor that infects the breath—the characteristic odour of dead bone being emitted, but in an excessive degree; and the existence of necrosis may always be positively determined by exploration of the nasal cavities with a probe.

The *Treatment* is simple, and must be conducted on ordinary medical and surgical principles. If the general health be impaired, or if the disease be specific, appropriate alterative constitutional treatment must be adopted. The fetor may be lessened by the injection or snuffing up of disinfecting liquids, more particularly the chlorides and permanganates. So soon as the bone is loosened, it must be extracted with polypus forceps, coming away in soft black crumbling, offensive masses. There is often abundant hemorrhage after this extraction, but I have never had serious trouble given in these cases; plugging may possibly be required if cold do not arrest the bleeding.

LIPOMA is a chronic hypertrophy of the cutaneous and subcutaneous structures, and of the cellular tissue of the nose, forming a large reddish-blue, vascular-looking, soft, tremulous, and lobulated mass, enveloping the end of the nose, and producing excessive deformity of it. There are all degrees of this disease, from mere clubbing of the end of the organ, to the formation of a set of pendulous lobular tumours attached to it. The sebaceous glands and crypts appear to be the structures chiefly implicated in this disease. The patient's appearance may be greatly improved by the removal of these growths. This may be done readily enough by making an incision down the mesial line to the alar cartilages, and then dissecting the lipoma off these on each side; especial care, however, being taken in doing this not to encroach upon the nostril. This is best avoided by directing an assistant to keep his finger in it while the dissection is being prosecuted, so that he may warn the surgeon of the too near approach of the knife. The surface is then left to granulate and cicatrize.

LUPUS and EPITHELIAL CANCER.—The nose is frequently the seat of Lupus and various forms of Epithelial Cancer, many of the deformities of this feature being referrible to this affection; indeed, lupus may be looked

upon as almost specially affecting this organ, destroying one or both alae, the columna, or perhaps the whole of the nose. The consideration of the nature and treatment of these affections in this situation presents nothing special; but that of the cure of the deformities induced by them, which is full of interest to the surgeon, will be considered in detail when we speak of the plastic operations that are practised on the face.

POLYPUS.—Tumours of very different structures and composition are met with in the nostrils; and to all of these which possess the common characters of being pendulous and blocking up these passages, the term *Polypus* is given. Thus surgeons commonly speak of the *Benign*, the *Soft*, the *Gelatinous* or *Mucous Polyp*, as well as the *Sarcomatous* or *Fleshy*, and the *Malignant Polyp*. The term, however, should properly be confined to a soft and pendulous mucous growth; the fleshy and malignant polypi being mere varieties of fibrous or encephaloid tumours, springing from the bones in the nasal fossae, or from the ethmoidal and sphenoidal cells.

The true *Mucous Nasal Polyp* is a soft, moist, gelatinous tumour, of a greyish-yellow colour when lodged in the nasal fossae; but when it descends into the anterior nares, or beyond them, and is exposed to the air, it becomes of a reddish-brown or purple tint, and somewhat shrivelled on the surface. It is usually lobulated, pedunculated, or bottle-shaped; and not very vascular except at the root, where it is permeated by largish thin-walled vessels that bleed freely on the slightest touch. In structure it is homogeneous, and composed of the elements of mucous membrane, covered by tessellated and ciliated epithelium, the cilia of which may often be seen under the microscope in active movement after the removal of the growth. The tumour may grow from any points of the surface of the turbinate and ethmoid bones, and has indeed occasionally, though very rarely, been observed to project into the nose from the frontal sinuses and antrum. Most frequently it grows from the inferior spongy bone towards the outer side of the nostril, sometimes from the roof of the nares, but never from the septum.

The polypi are usually numerous and of all sizes; as they increase they commonly extend forwards into the anterior nares, but, when large, they may be seen to reach into the posterior fauces, hanging down behind the palate.

Symptoms.—The symptoms occasioned by the presence of nasal polypi depend on their interference with respiration and speech, and on the visual changes which they occasion. The respiration through the affected nostril is impeded, the patient being unable to blow through it when directed to do so, and his speech is thick and nasal. There are snuffling and mucous discharge from the nostril: and all these symptoms are worse in damp than in dry weather. On examining the interior of the nose, by opening the nostril widely with the forceps or nasal speculum (Fig. 316), and then directing the patient to blow down, the lower end of the polyp may be distinctly seen, and if large, will descend on a level with or even beyond the nasal aperture. By the introduction of a probe, the size and extent of the tumour, together with the position of its pedicle, may be readily

ascertained. As it grows, it impresses changes on the shape of neighbouring bones, producing expansion and flattening of the nose; it induces caries of



Fig. 316.—Nasal Speculum.

the spongy bones; and, interfering with the flow of tears down the nasal duct, occasions a watery state of the eyes, which, together with the change of shape in the features, and the peculiar character of voice and respiration, enables the surgeon at once to recognise the nature of his patient's disease. Polypi chiefly occur in young adults after the age of puberty; but they are not unfrequently met with at later periods of life.

Diagnosis.—1. Mucous nasal polypi may be distinguished from chronic thickening of the mucous membrane covering the spongy bones by the absence in the latter of any pedunculated growth around which a probe can be passed, together with the florid red character of the thickened membrane, and the fact that the subjects of this thickening are almost invariably strumous children. 2. In *abscess of the septum*, the history of the case, and the fact of the polyp never being attached to this part of the nose, will establish the diagnosis. 3. There is a peculiar malformation, consisting in a *deviation of the septum* to one side, that may at first be a little puzzling; but here the examination of both nostrils, and the discovery of a depression of one side of the septum corresponding to the projection on the other, will reveal the true nature of the case. 4. The *fibrous and malignant tumours* of the nostril will be found to differ sufficiently in consistence and appearance from the ordinary polypi to prevent their being confounded with them in many cases; yet in some instances much care will be required in coming to a definite opinion as to their true nature.

Treatment.—The spontaneous separation and expulsion of nasal polypi is of rare occurrence. I have, however, seen one case in which, after the assiduous use of chloride of zinc injections, a very copious discharge of large sloughy polypoid masses took place from one nostril which had been blocked up by them for many months previously, and from which they had even descended into the pharynx.

Nasal polypi may generally be most readily removed by avulsion with forceps; occasionally, but rarely, when they are very large, with a broad base, and especially when they extend into the throat, they require the application of the ligature. In removing these growths by the *forceps*, instruments of good length but very slender construction should be used, —those generally sold are too thick; the interior of the blades should be properly serrated, and have a longitudinal groove, so that the root of the tumour may be tightly grasped. The patient should be made to sit on rather a low chair; and, as there is generally a good deal of bleeding, a towel should be pinned over his clothes, and a basin placed before him to receive the blood and expectorated matters. The surgeon then, having ascertained by the introduction of a probe, or by means of the blades of the forceps, the situation of the pedicle of the polyp, grasps this firmly and pulls it off with a twisting movement of the hand. He proceeds in this manner, twisting off rather than pulling away polyp after polyp, until the whole of the nostril is cleared, which may be ascertained by examination and by directing the patient to compress the sound and to blow through the affected side of the nose. The bleeding, which is often very free, stops on the application of cold water. At about the end of a fortnight the patient should be examined again, as it not unfrequently happens that small polypi, which had been prevented from descending into the nares by the presence of the larger ones, now come down and require removal. These procedures must be had recourse to from time to time, until all tendency to fresh formations of this kind has ceased.

The *ligature* is chiefly required for those polypi that pass into the pharynx through the posterior nares. They may best be tied by passing a loop of

strong whipcord, by means of a double cannula, through the nose; and then, after expanding the noose round the tumour in the throat and making it grasp its pedicle, knotting it tightly. In some instances the polypus attains a great size, producing absorption of the nasal bones, and of the nasal process of the superior maxilla. In such cases, it may be necessary in order to extract them, to slit up the nose, and possibly clip away with forceps the osseous surface from which they spring.

When the tumour, more especially if fibrous or fibro-plastic, hangs down in the pharynx behind the soft palate, its pedicle may be ligatured by conveying a thread through the nostril by means of a Belloeq's sound, and attaching to this a loop of silver wire, which, as it is withdrawn through the nostril, embraces the base of the tumour. The noose may then be tightened by twisting up the ends of the wire, or by running a silver cannula along them.

FIBROUS TUMOUR.—The intranasal fibrous tumour (sarcomatous or fleshy polypus) is usually attached to the posterior part of the nasal septum, descending to the pharynx. It is globular, smooth, firm, and has little disposition to bleed or ulcerate. It may grow to a large size, extending into the throat, and perhaps finding its way from the nose into situations where it is little expected. Thus it has been met with in the pterygo-maxillary fossa, and has been known to pass into the orbit through a hole in its inner wall.

MALIGNANT TUMOUR (sometimes called malignant polypus), either encephaloid, or of a fibro-plastic or simply recurrent character, occasionally forms in the nostrils. It grows rapidly, with great expansion of the bones, much discharge, fetor, and bleeding, the hemorrhage being often excessive. It attacks children and persons advanced in life; extends into the pharynx behind the soft palate; and after a time has a tendency to press against, absorb, and protrude through the nasal or lachrymal bones, speedily destroying life by hemorrhage, cachexy, or secondary deposits. In such cases the surgeon may make an attempt to extract the growth in the ordinary way through the nostril; or this may even be slit up in order that the attachment of the growth may be more fairly reached; or, should the tumour protrude into the pharynx behind the soft palate, it may be extirpated from that situation. It is, however, seldom that anything very effectual or permanent can be done by operation; and it should be borne in mind, that some of the malignant growths which project into the nostrils take their origin from inside the cranium, or from the sphenoidal cells, and that the nasal portion is only the external protrusion, as it were, of a deeply-seated tumour.

CALCULI are occasionally met with in the nasal fossae, where they simulate foreign bodies; and here extraction may be practised with a pair of forceps. But sometimes these *rhinoliths* are situated under the mucous membrane. In two cases I have dissected round calcareous bodies of this kind, of about the size of cherry-stones, from under the mucous membrane of the ala of the nostril in children.

THE FRONTAL SINUSES, though rarely, are occasionally the seat of disease. *Abscess* may form here, with much pain and expansion, and possibly caries of their anterior wall, attended by the local signs of inflammation and by danger of concomitant inflammation of the membranes of the brain. In such circumstances it may be proper for the surgeon to consider the advisability of removing by a small trephine the anterior wall of the sinus, and thus giving exit to the retained pus. There are a few cases recorded in surgical writings, of Polypus springing from these sinuses, and finding their way down

into the nose after producing expansion of it and much inconvenience. Here likewise the propriety of trephining and so extracting the morbid mass would have to be considered.

TUMOURS AND ULCERS OF THE CHEEKS.—The cheeks are occasionally the seat of *Encysted Tumours* and *Cancerous Growths*, either springing from their inner surface, or taking their origin as *Lupoid Ulcers* on the outside. The *Encysted Tumours* in this situation may readily be removed by a little simple dissection. If they be attached to, or lie close under, the mucous membrane of the mouth, they may be dissected out from within, without interfering with the cutaneous structures. *Canceroid Ulcers and Tumours*, such as represented in Fig. 317, seldom admit of operative interference.

SALIVARY FISTULA.—One of the most troublesome surgical affections situated in the cheek is a *Salivary Fistula*, occurring in consequence of injury, abscess, or operation, by which the parotid duct has been opened, so as to cause a trickling of saliva through the external aperture made into it. If the fistulous opening be recent, the lips of the external wound may be brought together and made to close, while the internal aperture is free. If it be of old date, a seton composed of a few threads may be passed into the fistula from the inside of the mouth, so as to allow the saliva to find its way along this, whilst union of the external orifice is attained by paring its edges and bringing it together with hare-lip pins. My colleague, Mr. Marshall, has succeeded in closing an aperture of this kind by restoring the canal by means of a wire heated by galvanism, and then causing the external orifice to contract.



Fig. 317.—Canceroid Ulcer of Cheek.

DISEASES OF THE LIPS.

CONGENITAL MALFORMATION OF THE LIPS is of common occurrence. *Congenital Contraction*, or even complete closure of the orifice of the mouth, has been met with at birth: such a condition must be remedied according to circumstances by the skill of the surgeon. By far the most common malformation, however, is the condition termed *Hare-lip*, which will be noticed in detail in the chapter on the Plastic Surgery of the Face and Mouth.

HYERTROPHY to a great extent occasionally occurs in either or both lips. It is often of an oedematous character, being kept up by the irritation of fissures or cracks; if so, these must be cured, when the size of the lip will gradually diminish. Sometimes, however, it becomes permanent, continuing after the cure of the fissure; under these circumstances it may be necessary to excise an elliptical portion of the mucous membrane of the lip in a horizontal direction, and then to bring the edges together by means of sutures or pins.

ULCERATION is not unfrequently met with on the prolabium, frequently of a simple character, though chronic. It is frequently dependent on a disordered state of the digestive organs. It will commonly yield to the application of nitrate of silver, to proper constitutional treatment having for its object the improvement of the digestion, and in very chronic cases to the administration of the preparations of arsenic.

ENCYSTED AND ERECTILE TUMOURS.—The lips may be the seat of encysted and erectile tumours, requiring extirpation by the knife or ligature. In dealing with these, the surgeon must be guided by the circumstances of the individual case; but he should, if possible, avoid cutting through the whole thickness of the lip; and, if compelled to do so, he must act as will be described in speaking of cancer of this region. These growths more frequently occur on the lower lip.

Encysted Tumours are usually small and transparent, with thin walls, containing a glairy straw-coloured fluid. These should always be dissected out; mere excision of a portion of the wall being followed by recurrence of the disease.

Erectile Tumours of the lip are usually of an active character, and may either be excised, if of moderate extent and implicating the whole thickness of the lip; or, if of large size and projecting from the mucous surface, they may be safely ligatured (p. 688). I have had under my care several cases of *Nævus* of the upper lip, implicating the whole substance of the part, and have successfully removed them by the repeated application of potassæ cum calce.

MALIGNANT DISEASES OF THE LIPS.—Not unfrequently *Warty Growths* and various forms of *Epithelioma* and *Canceroid Diseases* appear upon the lips. These affections are not removable by therapeutic means, and require surgical interference.

Epithelioma of the lip either commences as a warty growth, which gradually ulcerates like the ordinary forms of tubercular lupus; or it begins as an indurated crack or fissure, the edges of which have a tendency to spread. The submaxillary glands tend to become involved: and the disease may eventually prove fatal by the pain, exhaustion, and constitutional irritation induced by them. *Epithelioma* almost invariably occurs in men, affects the lower lip, and is met with after the middle period of life. Of fourteen cases in which I have operated, seven were above sixty, and four between fifty and sixty years of age; in one case only did the disease occur under thirty. This disease is at first entirely local, often being induced by some irritation, as by a rugged broken tooth, or by smoking a clay-pipe; and when removed it does not, I believe, very commonly return. At least, of the very many cases that have been operated upon at the University College Hospital, I have only known one patient return with a recurrence of the disease, and I do not recollect any case of secondary affection of this description to have applied to that institution after having been operated on in other hospitals; I cannot, therefore, but come to the conclusion that the operation for epithelioma of the lip frequently cures the patient permanently of disease.

When the glands under the jaw are enlarged in this disease, it is a question whether an operation should be done; but I think decidedly that extirpation of the disease and removal of the enlarged glands (provided that the surrounding soft parts be not involved) should be practised if the patient be in a good state of health, as he will thus be placed in a more favourable condition than before the operation, and will have a better chance of prolongation of life.

Operation.—When once the true nature of the disease has been ascertained, the operation should be performed with as little delay as possible, but, before it is done, it is well that any very prominent or broken tooth should be removed, and the tartar cleaned away from the incisors. The operation requires to be somewhat modified, according to the situation and extent of the affection (Fig. 318). If this be tolerably limited, a V-shaped

cut, extending widely round it, and carried sufficiently low to include any indurated prolongation of the absorbents, should be practised; the edges of



Fig. 318.—Epithelioma of Lower Lip:
Lines of Incision

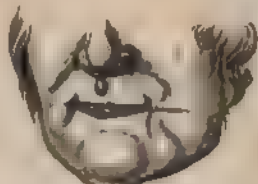


Fig. 319.—Lip after Removal of
Epithelioma.

the cut should then be brought together by two hare-lip pins with a twisted suture, as in the case of a simple hare-lip. When the disease occupies a considerable longitudinal extent, but does not dip down very deeply, a slice of the lip should be shaved off, including the whole of the morbid structure; and it is often surprising, under these circumstances, to observe how the tissues of the lip will speedily rise to their natural level, thus preventing any material deformity from being left (Fig. 319). In some cases the disease occupies a square surface, and then it is necessary to excise a portion of the lip; when this is done, a considerable gap is left, requiring to be filled by some plastic operation of the kind that will be considered in a subsequent chapter (LVIII.), which may be most conveniently done at the time when the excision is performed.

DISEASES OF THE PAROTID GLAND.

PAROTITIS, or **MUMPS**, is a common affection, especially in children, though it not unfrequently occurs in adults. It arises usually from cold and wet, and is frequently infectious. Both sides of the neck are usually affected, and the swelling, stiffness, and pain are often considerable, though it very rarely happens that suppuration occurs, unless it be in the lymphatic glands of the neighbourhood. Metastasis, though of rare occurrence, has been described as occasionally happening to the testicle or breast.

The *Treatment* of this affection is simple. If it be severe, the application of hot fomentations and leeches, the administration of saline purgatives, and, when the affection is on the decline, frictions with camphorated oil, will hasten its resolution.

TUMOURS.—Tumours of the parotid gland itself are not so frequent as morbid growths situated upon it or in its vicinity; yet occasionally they consist in an actual transformation of its structure. The tumours met with in this region may be simple or malignant. When simple, they are usually of a *fibrous* nature and often *encysted*; they are hard, deeply attached, but moveable on careful manipulation; round, and of very great size, becoming even as large as a cocoa-nut (Fig. 320); the skin covering them is thin but not ad-

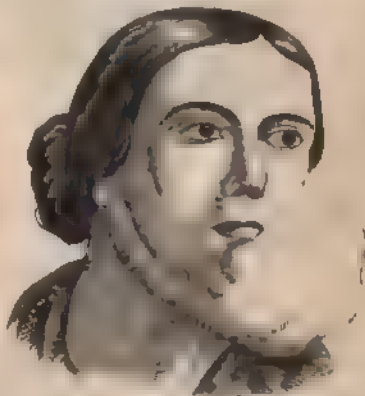


Fig. 320.—Fibrous Tumour of Parotid too
large for Removal.

herent, and not unfrequently a network of veins covers the mass. These growths frequently send prolongations under the ramus of the lower jaw, and then occupy the whole of the space between its angle and the mastoid process; when firmly bound down, they involve the blood-vessels and nerves



Fig. 321.—Tumour of Parotid

in this important region, coming into relation with the styloid process and its muscles, and even pressing upon the pharynx, as was the case with the patient from whom the preceding cut (Fig. 320) was taken. In consequence of the large size that these tumours may attain, they have a tendency to produce atrophy of the parotid, and often, by interfering with the cerebral circulation, occasion various congestive symptoms about the brain. Besides the fibrous, various other simple tumours, such as fatty, enchondromatous, and encysted, occur in the parotid region. These present nothing remarkable in their course here. In some cases the parotid may undergo cancerous infiltration, the tumour then presenting the characters and running the course of the ordinary forms of malignant disease.



Fig. 322.—Tumour of Parotid Back View.

These present nothing remarkable in their course here. In some cases the parotid may undergo cancerous infiltration, the tumour then presenting the characters and running the course of the ordinary forms of malignant disease.

Diagnosis.—It is of great importance to effect the diagnosis between the non-malignant and the malignant varieties of tumours in the parotid region. In the fibrous, fibro-plastic, fibro-cellular, and enchondromatous tumour, there is always mobility; and, although the attachments may be deep, the skin is not involved to any extent. The outline of the mass is usually well defined, square, and somewhat lobulated. The progress of the growth is very slow, often occupying many years before it attains any considerable bulk, as in the annexed cuts (Figs. 321, 322), representing a tumour of sixteen years' standing, which I excised. In the scirrhus

growth there is no mobility, but the mass is solidly fixed; its outline is ill defined, the skin soon assumes a reddish-purple colour, is brawny, and presents the usual characters indicative of subjacent malignant action.

When these tumours are *medullary*, they grow with considerable rapidity, feel soft and pulpy, and are rounded and ill-defined in their outline, especially under the ear and by the ramus of the jaw.

Treatment.—In the treatment of these tumours, extirpation is necessarily the only course that can be adopted; and this in my opinion should not be attempted if the disease be malignant; for, as it would be impossible to remove its deeper attachments, the growth to a certainty would speedily return. Even if the disease be of a simple character, care must be taken that every lobule and prolongation be extirpated; for, if any be left, however small, it will without doubt become the nucleus of a new tumour. In removing tumours in this situation, the superficial incisions should be free, and either longitudinal or crucial, so that the whole mass may be fairly exposed. It is not wise to remove integument, however redundant this may appear to be, unless it have undergone infiltration, incorporation with the tumour, or change of structure; and even then as little as possible should be taken away. The fibrous or aponeurotic investments of the tumour must be fairly opened, and the edge of the knife must then be directed against it, and the dissection carried on from below upwards, or from behind forwards, so that one division of the blood-vessels supplying it may be sufficient. After the tumour has been well loosened by the division of investing fasciæ and structures (and it is surprising how moveable it often becomes after this has been done, though it may previously appear to have incorporated somewhat solidly with the subjacent tissues), it should be taken hold of by the hand or a large double hook, and drawn well forwards whilst the deep dissection is being carried on. In prosecuting this, the surgeon must particularly guard against wounding the temporo-maxillary artery and the portio dura nerve, which are especially exposed to injury. In some cases the division of these, especially of the artery, cannot be avoided, as they are incorporated in the mass that is undergoing removal. The hemorrhage would then of course be abundant, but may usually be immediately arrested by the ligature of the divided artery; indeed, in most cases the bleeding is profuse, owing to the unavoidable section of nutrient vessels and of large subcutaneous veins, but may generally be readily arrested by ligature and pressure. In most instances, however, by keeping the edge of the knife carefully against the tumour and by drawing it well forward, so as to loosen it in its cellular bed at each stroke of the scalpel, removal of the morbid mass may be effected without the division of any important vessel or nerve. It is of more consequence to avoid a wound of the portio dura or of the chief branches of the pes anserinus, than even of the temporo-maxillary artery; as persistent and incurable paralysis of the jaw would result from such an injury. Injury to this nerve is best avoided by dissecting out the tumour by incisions parallel to its main trunk and chief branches, and especially by drawing the mass well forward, and directing the knife towards it. After the extirpation of some small fibrous or encysted tumours in the substance of the parotid, there is often a great tendency to copious secondary hemorrhage, requiring pressure, or even the application of the actual cautery, for its arrest.

If the tumour, though non-malignant, have been allowed to attain an enormous size, developing at its deeper attachments as well as superficially, with large lobes lying behind and under the ramus of the jaw, in close relation with the pharynx, the internal carotid, and jugular vein, it would not be prudent to attempt its removal.

Excision of the Parotid Gland itself is occasionally spoken of, but is very rarely if ever done. I believe that in most, if not all, the cases in which

it is stated that complete removal of this gland has been accomplished, tumours overlying and compressing it have been mistaken for it. It is evident that a diseased parotid could not be removed without the division of the external carotid artery and facial nerve.

TUMOURS OF THE NECK.

Besides tumours in the parotid region, *Fatty, Fibrous, Glandular, and Encysted Growths* are not unfrequently met with in the *Submaxillary Space*, and in the *Triangles of the Neck*. In these situations they may occasionally attain a considerable size, though they seldom extend very deeply, being superficial to the deep fascia. Hence, when the integuments and superficial structures covering such a growth are divided, it may be insulated with sufficient facility, its fixity being in a great measure due to its being bound down by the investing fascia, rather than to its having contracted deep adhesions. Occasionally, though rarely, a slowly growing tumour develops deeply in the anterior triangle of the neck, lying between the sterno-mastoid, the trachea, and the pharynx, possibly even under the carotid sheath, with the artery pushed on one side, or even running over the anterior convexity of the growth. In such cases, the question of removal requires to be approached with the utmost caution. If the tumour be moveable above the vessels, it may generally be taken out; if it lie below the sheath, even though not fixed to the spine, its extirpation is not practicable. Before determining upon the removal of a tumour situated in one of the triangles of the neck, it is indeed always very necessary that a diagnosis be effected of its nature, and that some opinion be formed of the probable extent of its deep attachments.

The first point to ascertain is, whether it be simple or malignant. If simple, it will usually have been many years in growing; it will be hard but not stony, lobulated or somewhat square-shaped; the patient's general health being good. It will generally be found to be moveable, though not perhaps to any great extent, and will present no sign of incorporation with neighbouring structures; the fibres of the platysma will not appear to spread over it, and the sterno-mastoid muscle may be traced to one side of or below it. Under such circumstances, removal of the tumour may be undertaken by any surgeon possessing a fair share of anatomical knowledge and manual skill, with every prospect of success. But if the tumour be of stony hardness, have implicated the skin, and be immovable, the whole head being moved on any attempt at drawing it aside; if it be ill-defined under the jaw and ear, or rapidly growing, soft and pulpy to the feel, deeply seated under the angle of the jaw, evidently below the platysma and deep fascia of the neck, and possibly beneath the sterno-mastoid, then no attempt at extirpation should be undertaken, as the mass could either not be removed with safety, or, if it were by any possibility extirpated, then already existing contamination of the neighbouring parts would certainly lead to a speedy recurrence of the disease. In removing *submaxillary tumours*, a free superficial incision nearly parallel to the margin of the lower jaw, but below this, will usually allow ready extirpation of the mass. In these operations the facial artery is generally sufficiently under cover of the bone to escape injury, but there may be, and usually is, free venous hemorrhage.

HYDROCELE OF THE NECK.—A peculiar cystic tumour, hydrocele of the neck, has been described by Maunoir and Phillips. The disease usually appears in the posterior inferior triangle, forming a rounded tumour, smooth, tense, and elastic, unilocular in some cases, multilocular in others; filled with a yellow or chocolate-coloured sero-albuminous fluid. It may attain

so large a size as to interfere with deglutition and respiration. The largest I have seen was of the size of an orange. The skin covering this tumour is not discoloured, in some cases of natural thickness, in others thin and expanded, so as to give a bladder-like appearance to the growth.

The *Treatment* of this tumour consists in tapping, when complete collapse of the cyst takes place; which, however, will soon fill again. A permanent cure may be effected by injection with iodine, or by passing a seton across.

ENLARGEMENT OF THE LYMPHATIC GLANDS of the neck, terminating either in chronic induration or in abscess, is of such common occurrence as to constitute perhaps the most frequent form of glandular enlargement. The tumours thus formed present nothing peculiar in their progress or treatment when occurring in this situation; except that when abscess forms it should be opened early by a small incision, and in such a direction, corresponding to the natural folds of the skin, as to leave as little scarring as possible.

BRONCHOCELE.

The thyroid gland is subject to various chronic enlargements which commonly go by the name of *Bronchocele*. These may be divided into three distinct forms.

1. **SIMPLE HYPERTROPHY.**—The thyroid gland may be simply hypertrophied, and may then attain a very considerable size; in some cases forming an immense lobulated tumour on the forepart of the neck, such as is met with in various districts of this country and of the continent, in which the disease is endemic. In the majority of instances, however, the tumour is of but very moderate size, commencing at first as a mere fulness and uniform or rounded enlargement of the isthmus, or of one of the lateral lobes of the thyroid gland, and gradually increasing, until perhaps, by the pressure of the growth confined between the sterno-mastoid muscle and the deep structures of the neck, respiration and deglutition become seriously affected. There is a remarkable connection between tumours of the thyroid gland of this kind, and a general anæmic condition of the system. In London nothing is more common than to find a certain degree of bronchocele in pale and bloodless women and girls; indeed so frequent is the coincidence that it is impossible not to regard it in the light of cause and effect. Great prominence of the eyeballs is frequently associated with these conditions. In practice we constantly observe this triple pathological sequence, viz., anæmia, exophthalmos, and bronchocele; and the connection of these has been commented on by Graves, Basedow, Sichel, White Cooper, Aran, Begbie, and numerous other authors.

2. **CYSTIC BRONCHOCELE** is owing to the development of cystic tumours in the thyroid gland, either associated with, or occurring independently of, general hypertrophy of it. These cysts, which may be single or numerous, usually contain a dark, bloody-looking fluid, and have often cauliflower-like excrescences projecting into their interior.

3. **PULSATING BRONCHOCELE** is occasionally met with. The pulsation, which is excentric and distensile, is synchronous with the heart's action, and evidently due to the vascular character of the tumour itself. This form of bronchocele is sometimes conjoined with the cystic; when it is confined to one lobe only, care must be taken not to confound the beatings with carotid aneurism; a mistake which I have known to occur, and the diagnosis of which has been adverted to at page 629.

TREATMENT.—The treatment of bronchocele must vary according to the size and character of the tumour. When small, and associated with anæmia, and of comparatively recent formation, it is best treated by improving the

general condition of the patient by the administration of iron internally, especially the iodide, with the external application of iodine or of iodide of lead ointment. Indeed, in the soft bronchocele occurring in anæmic exophthalmic females, iron is of the utmost service, and acts almost as a specific.

In bronchoceles of large size, hard, and unconnected with anæmia, the chief reliance is to be placed on the free and continuous use of iodine internally as well as externally. Iodide of lead and compound iodine ointment may be used with advantage. It has been recommended by Dr. Mout that thebimiodide of mercury ointment (16 gra. to the ounce) should be well rubbed in for several days; and then, the tumour being covered with it, the patient should be exposed to the strong heat of a mid-day summer sun. This method of treatment, which is said to have been extremely successful in India, has not been tried in this country to a sufficient extent to enable an opinion to be formed of its merits. In some instances pressure has been of use, especially in conjunction with the iodine inunctions; though it is not so easy to apply this means, and any considerable degree of it can necessarily not be borne, on account of the increased difficulty of respiration that is thus occasioned. In fact, the compression exercised upon the tumour by the sterno-mastoid muscle in some of these cases is occasionally so considerable, that it becomes necessary to divide its tendon subcutaneously, in order to relieve the trachea from the constriction to which it is subjected. When the tumour is chiefly cystic, the fluid contents may be drawn off by tapping, and an endeavour may be made to cause the cysts to close by inducing inflammation in them by the injection of tincture of iodine. When bronchocele is very large, its absorption cannot, I think, be expected to take place by these or any other means; and the question then arises as to the propriety of having recourse to operative interference. *Excision of the tumour* is seldom to be thought of; the disease, even though of large size, not being detrimental to life. The vascularity of the tumour is so great, and the arterial supply that it receives from both sets of thyroid arteries so abundant, that any attempt at extirpation must generally be attended by such profuse hemorrhage as necessarily to prevent the completion of the operation. Cases have, it is true, occurred to Roux and others, in which large bronchoceles have been successfully extirpated; but these operations must be looked upon as altogether the exception in the treatment of the disease; and instances are certainly not often met with, in which a surgeon would think it proper to undertake so serious a procedure for an affection that is not necessarily mortal. I have more than once been tempted to remove large pendulous pedunculated bronchoceles, but close examination has satisfied me in all such cases that the neck of the tumour was so vascular, containing large arterial and venous branches, and so intimately connected with the sheath of the carotid, stretching under the sterno-mastoid, which was expanded over it, that no operation could be safely undertaken. In the event of its being thought desirable to operate, the better plan would be, after exposing the tumour, to enucleate it as much as possible with the handle of the scalpel, ligaturing carefully all the vessels divided as they were cut.

Ligature of the thyroid arteries has been practised by some surgeons, with, it is stated, a certain degree of success. The difficulties and danger of the operation, the uncertainty of its results, and the readiness with which the arterial supply would be forwarded to the tumour from other sources, have caused it to be but little resorted to by surgeons of the present day. In one case of pulsating bronchocele in which I had recourse to this treat-

ment, no benefit resulted from it. The introduction of a *seton* across the tumour is occasionally attended by beneficial results. This operation, however, is not unaccompanied by danger; a patient in the neighbourhood of London, on whom it was being performed a few years ago, lost his life by the puncture of a vein at the root of the neck, into which air was spontaneously admitted. *Injection of perchloride of iron* by means of the syringe figured at p. 683, is likely to be of service in some cases of very vascular and pulsating bronchocele. In one instance of the kind in which I employed it, although much local inflammation and deep-seated suppuration was induced by it, the patient was in the end materially benefited.

CHAPTER LVI.

DISEASES OF THE JAWS AND THEIR APPENDAGES.

DISEASES OF THE GUMS AND ALVEOLAR PROCESSES.

ABSCESS OF THE GUMS is of very frequent occurrence, from the irritation of decayed teeth. Here a free and early incision should be made; which, by giving exit to the pus, will afford immediate relief.

SPONGY AND SLOUGHY ULCERATION OF THE GUMS will occur as the result of constitutional cachexy induced in any way—by mercury, malaria, syphilis, &c. It is best treated by tonics, in conjunction with the chlorate of potash and mineral acids internally. If it spread actively, escharotics, such as hydrochloric acid or creasote, may be advantageously applied. If it do not make much progress, a solution of nitrate of silver, with chlorinated or tannin gargles, will be useful.

EPULIS is a tumour springing from the periostum and edge of the alveolus, and implicating the osseous walls: it grows up between and loosens the neighbouring teeth, which it displaces and envelops in its structure. It is of two kinds; *simple* and *malignant*. The *Simple Epulis* is a fibrous tumour; the *Malignant* is usually myeloid—if the term “malignant” can be applied to that form of tumour; but it is also occasionally cancerous.

Epulis is most frequently met with in the lower jaw. I have, however, seen several instances of it springing from the alveolus of the upper jaw. It appears chiefly to be occasioned by the irritation of decayed stumps, and hence is more frequently met with in connection with the molar than with the incisor teeth. Although this disease has occasionally been met with in children, it seldom occurs before the adult age, and then may be developed at any—even up to an advanced—period of life. It is seen then as often among females as males. A fibrous epulis appears as a red, smooth, and lobulated tumour, at first hard and semi-elastic, like the ordinary structure of the gum, but after a time softening by disintegration, and ulcerating on the surface, with a purulent or sanious discharge. The fibrous variety appears simply to be a circumscribed and rapidly-growing hypertrophy of the gum.

Treatment.—The treatment of epulis consists in the removal of the whole



Fig. 322.—Epulis of lower jaw.

of the mass and of that portion of the alveolus from which it springs. As it evinces a great tendency to reproduction, it must not simply be shaved off the bones, but a portion of the osseous structure must be removed as well; unless this point be attended to, the growth will to a certainty be reproduced. In all ordinary cases of simple epulis, this may be done from the inside of the mouth without the necessity of making any incisions through the cheek. In very large epuloid masses, more particularly of the myeloid variety, and extending towards the ramus, it may be necessary either to carry an incision from the angle of the mouth downwards and outwards, or to dissect up the cheek from the bone, and thus expose the disease fully. In performing the operation, the first thing to be done is to extract a tooth contiguous to and on each side of the tumour; a cut must then be made with a saw through the alveoli of the teeth that have been removed, down to a level with the base of the growth. In doing this, care must be taken not to cut too near the remaining teeth, lest the alveoli be opened and their support lost. If the tumour be large, it may be necessary to saw deeply, but the base of the lower jaw should, whenever practicable, be left intact, the whole of its substance not being sawn through, so that, though a considerable portion of bone be removed, yet the length of the jaw may be preserved. For this purpose Hey's saw should not be used, as it is a niggling instrument, difficult to manage in this situation; but a straight and stiff-backed saw, with as deep a blade as the mouth will conveniently admit, will be found most useful (Fig. 233). The epulis, included between two vertical cuts, may now, if small, be removed with cross-cutting forceps, and the bleeding stopped by placing a plug in the wound and compressing it against the teeth of the upper jaw by means of a bandage passed under the chin. If the epulis be large, a horizontal cut should be made along the bone about midway between the alveolus and the base, by means of a Hey's saw; and, after the bone has been penetrated to a sufficient depth, the blade of the cross-cutting forceps may be fixed in this cut, and the diseased part then removed. Should there be a spouting dental artery, it may be necessary to apply a red-hot wire, or the perchloride of iron, in order to arrest its bleeding. The cut surface will speedily granulate; and the cavity fills up with fibrous tissue. The operation for the removal of epulis is a very safe one. Of 28 cases collected by Hutchinson from different London Hospitals, one was fatal; and that one from pyæmia.

Malignant Epulis.—Cancerous ulcers and fungous fibro-plastic growths from the alveolar processes, *malignant epulis*, as they are called, occur in the same way as the last; but they are soft, purplish, very vascular, grow rapidly, and are speedily reproduced after removal; they principally, so far as my observation goes, occur in males advanced in life. The same operation requires to be practised for these diseases as for the simple epulis, and, as there is usually much hemorrhage following their removal, a red hot iron must be applied to the bleeding surface. If a malignant epulis be of very large size, it may be necessary to remove a portion of the whole thickness of the bone, through an external incision, as will be described in the section on Excision of the Lower Jaw (p. 876).

NECROSIS OF THE JAWS is commonly the effect of blows, of salivation by mercury, of syphilis, of fever, or of exposure to the fumes of phosphorus. I have, however, seen the disease occur idiopathically in otherwise healthy subjects, without any assignable cause. In this way I have seen the whole of the alveolar process of the upper jaw exfoliate in a young lady, otherwise perfectly healthy; and I have several times had occasion to remove large portions of the lower jaw—in one case more than half of the bone—for necrosis

that was not referrible to any of the causes mentioned above, or indeed to any assignable reason. The disease begins with deeply seated pain resembling inveterate tooth-ache, which nothing will allay; the gums become swollen; the teeth are loosened, and eventually drop out. Before they do so, however, pus usually wells up through the alveoli. Abscesses form outside the mouth and under the angles of the jaw—having fistulous openings through which bare bone is reached by the probe. The general health suffers greatly in these cases, more so than in necrosis generally, doubtless in consequence of the patient swallowing some of the pus from the dead bone.

Necrosis of the jaws, arising from the inhalations of the fumes of phosphorus during the manufacture of lucifer matches, first noticed by Lortner of Vienna, has been especially described by Von Bibra and Geist, who had abundant opportunities of observing the disease at the large manufactures at Nuremberg. This *Lucifer match disease* has of late years also been observed in many cases in this country. It consists in necrosis of the jaws, and is attended by the symptoms just described, but in a severer degree and an acute form. Both jaws are equally liable to be affected; but commonly one only at a time is diseased, and the whole of the bone may die and be separated. Thus of 51 cases observed by Von Bibra, both jaws were affected in 5 instances only—the upper alone in 21 cases, the lower in 25. It appears that workmen having sound teeth are not easily if at all influenced by the fumes; but, if any tooth become carious, then the effect of the fumes will eventually manifest itself by the induction of necrosis, the action extending probably through the carious tooth into the interior of the alveolus.

Treatment.—The treatment of necrosis of the jaws presents nothing special. The removal of the sequestra should be effected as far as practicable through the interior of the mouth, by free incisions through the gums.

In the upper jaw, where the necrosis seldom extends beyond the alveolar border or the palatal process, this may always readily be done.

In the lower jaw, the question as to whether the dead bone should be extracted through the inside of the mouth, or by incision from without through the cheek, will be determined partly by the position of the sinus and partly by the situation and extent of the bone affected. This may in a great measure be ascertained by the situation of the sinus leading down to it. If these be in the cheek, or in the side of the neck, or under the angle of the jaw, it is usually an indication that, if the whole of the corresponding sinus or body of the bone be not involved, the posterior and outer parts are certainly affected; and, under these circumstances, extraction of the sequestrum is best effected by opening up the sinus parallel to the line of the jaw, and removing the necrosed bone in the usual way. The incisions for this purpose need not usually be very extensive. If the operation be delayed, in accordance with those principles that guide us in the management of necrosed bone generally, until the sequestrum is quite loose, it may usually be readily extracted, in whole or in pieces, through an opening that will leave but a small cicatrix. By such operations as these, the whole of the lower jaw has been extracted piecemeal at intervals in a state of necrosis, first on one and then on the other side. *Cornelius* has removed the whole of the necrosed lower jaw at one operation, dissecting first one and then the other condyle in the usual way.

If, however, there be no external abscess or sinus—if the gum have been loosened and perforated, with a ragged portion of sequestrum protruding through it into the cavity of the mouth, then no external incision will be

required, but the dead bone may be readily removed from within the mouth. Large portions of the jaw may thus be removed. I have taken away the whole of one ramus with its processes entire through the gum, without any external incision: and in a negro, the whole of the bone in a state of necrosis has thus been removed in separate pieces, by Perry, through the inside of the mouth.

The amount of regeneration of bone will depend greatly upon the state of the periostum before the removal of the sequestra. If this be healthy, and if new bone have already formed prior to operation, a very perfect reproduction of the portions of jaw removed may take place. Should no new bone have formed before the operation, a dense fibroid cicatricial structure will replace the removed bone.

DISEASES OF THE ANTRUM AND UPPER JAW.

Our present knowledge of diseases of the jaws, and of the operative procedures necessary for their removal, is chiefly due to the labours of Gensoul and of Liston. O'Shaughnessy also, who appears to have had many opportunities of witnessing these affections amongst the natives of India, has added much to our acquaintance with their pathology and treatment.

DROPSY OF THE ANTRUM, from accumulation of glairy mucus like the contents of a ranula or ganglion within this cavity, occasionally occurs. As the aperture leading from this cavity into the nose is a little above its floor, there may be a natural tendency for the fluid secreted here to accumulate to some extent before it is discharged; and if this aperture be from any cause blocked up, the secretion may increase to so great a degree as to occasion serious inconvenience by its outward pressure. In such cases the accumulation of fluid has been known after a time to expand and absorb the osseous walls of the cavity, so as to constitute a true cystic disease, and in this way the floor of the orbit or the roof of the mouth may be caused to bulge, the nasal cavity may be encroached upon, and the cheek rendered round and prominent—an indolent semi-elastic tumour forming in it and protruding it outwards, and giving rise to the egg-shell or parchment-like crackling on pressure.

Treatment.—Catheterism of the antrum may be practised in these cases by passing a curved probe along the side of the nostril between the superior and middle turbinate bones; where, in the middle meatus, about its centre, the aperture leading into the sinus may be felt. Should this treatment not succeed, the antrum must be opened from without: this is done by dissecting up the cheek from the gum, and thus making an opening into the cavity of the antrum with a strong pair of scissors or a perforator, through its most expanded and thinnest part, and leaving a plug of lint in the aperture, so as to allow the discharge to escape freely. The shape of the cheek may be restored by the gradual pressure of a spring pad or double-headed roller.

SUPPURATION may take place in the antrum. It is usually excited by the irritation of a carious molar tooth, or by some injury of the face, and occasions perhaps much throbbing or lancinating pain. The pus, as it forms, will sometimes overflow, as it were, into the nose through the aperture into the middle fossa, and then may keep up constant irritation, with much fetor in the nostrils; in other cases, it drains through the socket of a tooth into the mouth; and in other instances again, its exit being prevented, it gives rise to enlargement of the cheek, the soft parts of which become brawny and inflamed, and the bones expanded, so that at last they are thinned to such an extent that, as in dropsy of the cavity, they crackle when pressed upon. Any portion of the wall of the cavity—the orbital, buccal, palatal, or

nasal—may thus be expanded and fluctuation be felt through it; and, the lachrymal duct being commonly obstructed, the eye on the affected side becomes watery.

Treatment.—The treatment of this condition consists in the extraction of any carious tooth seated in the neighbourhood of the antrum; or, if the teeth be all sound, in the removal of the second molar, the fangs of which come into close relation to, and frequently perforate the bottom of, the cavity. In this way an exit should be given to the matter; but as it will not discharge itself sufficiently freely, the antrum must be opened through the alveolus, or through the canine fossa under the cheek, provided it be much expanded in this situation, so that its cavity can be easily reached. The perforation into the antrum may readily be made, or the socket of the tooth enlarged, by means of a triangular antrum-perforator, such as here represented (Fig. 324). As the matter drains away, the cavity will gradually contract, and the deformity thus be removed. It is well not to attempt to perforate in the site of teeth that have been extracted for some length of time, as here the bone becomes unduly consolidated, and I have consequently seen failures in reaching the cavity occur. The matter that is discharged is often very offensive, or it may be thick and pasty from the absorption of its watery parts. After the aperture has been made, the cavity should be syringed out with tepid water, and its shape gradually restored by pressure.



Fig. 324.—Tri-
angular An-
trum-perfor-
ator.

Tumours of various kinds spring from the upper jaw, taking their origin either from the surface of the superior maxillary or malar bones, from the interior of the antrum, or from the pterygo-maxillary fossa.

Those that grow from the *Surface of the Bone*, are either some of the various forms of *Epidis* that spring from its alveolar border, and must be treated as already described; or they are *Exostoses* growing from the outer surface of the bone, projecting perhaps up into the orbit, and requiring removal with the saw, bone-nippers, or gouge. In doing this, care must be taken not to destroy the nasal process of the bone, lest the lachrymal sac be opened.

The tumours that spring from the *Malar Bone*, from the *Cavity of the Antrum*, or from the *Posterior Part of the Upper Jaw*, are of very various kinds: fibrous, recurring fibroid, cartilaginous, osseous, fatty, fibro-plastic, erectile, and encephaloid growths may all be met with in this situation. In the Museum of University College, which is very rich in specimens of these tumours, most of the above-named varieties will be found. The *Fibrous Tumour* is perhaps the most common; it principally occurs in elderly people, and may attain very considerable bulk. The *Encephaloid* comes next in order of frequency; and the *Osseous*, *Enchondromatous*, and *Myeloid* occur, but are extremely rare. The osseous tumours are remarkable as occasionally appearing to set up a spontaneous attempt at elimination, by necrosis taking place in them.

Situation and Symptoms.—Encephaloid, myeloid, and osseous tumours occasionally spring from the surface of the malar bone, pushing forward the cheek, spreading into the mouth, and involving, with greater or less rapidity, according to their malignancy, the soft structures of the face and the lymphatic glands under the jaw. They are usually rapid in growth, irregular in outline, and only secondarily implicate the superior maxilla and neighbouring cavities. The various growths that are connected with, or

spring from, the mucous membrane of the antrum expand and dilate the walls of this cavity, pressing them, and giving rise to a considerable protrusion of the face. The tumour thus formed is oval, slightly lobed perhaps, more especially if fibrous in character. As it increases in size, it encroaches on the nasal cavities lying in the vicinity of the antrum. It presses on the palate, causing considerable swelling in the roof of the mouth, on the alveolar processes and teeth, giving rise to irregular protrusion. It may encroach upon the orbit, occasioning stilted vision, and impairment of vision. As the tumour enlarges, it stretches back into the pharynx, interfering with deglutition, and occasions sometimes severe epistaxis. In the early stage, and of a lloid character, obstruction of the nasal fossa will be the earliest sign, leading to the suspicion of polypus. As the disease is observed speedily to become involved, the glands of the maxillary absorbent glands enlarged.

Diagnosis.—In the diagnosis of these tumours, the following points are to be attended to:—1, to distinguish them from other tumours; 2, to determine whether the growth be simple or compound; 3, to ascertain its primary seat.

1. In making the diagnosis from *fluid accumulations*, the history of the case, and the uniform enlargement of the tumour projecting externally beyond any part of the face, lead the surgeon to determine that it is not of a solid character. This is not sufficient; and it becomes necessary to resort to exploratory puncture by means of the perforator, through the thinned and expanded parts already indicated. This is necessary in cases of doubt; for it has happened even to the most experienced that, after making incisions through the cheek with the tumour, the bones were found to be expanded and the operation had been undertaken, consequently, the operation had been undertaken.

2. In determining whether the growth be of a solid or fluid character, the surgeon will experience much difficulty, if the cavity of the antrum; but when once it has penetrated its walls, this point is easily solved. Whilst the tumour is within the antrum, much light may, however, be thrown upon the rapidity of its growth; the great point there is to suspect that it is malignant. Yet, the signs are of value, too much importance must not be placed upon them as a general rule, fibrous and cartilaginous tumours grow more rapidly than the malignant, yet it may happen that the malignant grows more rapidly in a short space of time. With regard to the value of the signs in a diagnostic point of view, that, as a general rule, simple tumours are more common in young, whilst the malignant forms of the disease are more common with at the middle or advanced periods of life. In a diagnostic point of view, to examine the condition of the glands. When the disease is malignant, they become enlarged at a very early period. In a case under my care of a tumour, whilst still in the antrum, was detected being a long chain of indurated lymphatic glands in the lower jaw, where they had become secondary.

where the bones had been perforated by the growth. When once a malignant tumour has passed beyond the cavity of the antrum, and is thus freed from the pressure of its walls, it grows with great rapidity. Insinuating itself extensively amongst the bones of the face and skull, it creeps through the foramina and fissures, encroaches greatly on the nasal cavity and orbit, implicates the integuments of the cheek and the soft structures within the mouth, and throws out sprouting masses in these several situations, which present all the characters of the true malignant fungus.

3. A point of very great importance in relation to operative interference is to determine the *primary seat of the tumour*; whether it spring from the cavity of the antrum, from the malar bone, or from behind the superior maxilla in the spheno-maxillary or pterygo-maxillary fissure. In the former case, the nasal or the palatal walls of the antrum are expanded, and the line of teeth is rendered irregular. When the tumour primarily springs from the malar bone, it pushes forward the cheek into a somewhat conical prominence, and dips down into the mouth between the gums and the soft structures of the face. It does not involve the orbit or palate, or alter the hue of the teeth, but rather spreads over the bones, and involves the covering soft parts by continuity of tissue, without any definite anatomical disposition. As the tumour increases in size it will implicate the anterior wall of the antrum, and thus secondarily project into that cavity.

When the disease develops primarily *behind the superior maxilla*, that bone will be found to be simply pushed bodily forwards, there being little if any deformity in its outline, the line of teeth not being displaced, nor the walls of the antrum—palatal, nasal, or orbital—expanded. Yet it must be borne in mind that the difficulty of diagnosis is greatly increased by the fact that a tumour, though not originating in the antrum, may pass into the orbit through the spheno-maxillary fissure, and may make its way forwards amongst the bones of the face, partly by creeping through, and partly by absorbing and displacing them.

Treatment.—In the treatment of tumour of the antrum, nothing can be done except to extirpate the growth; and it is consequently of great importance to distinguish those forms of the disease in which an operation can be undertaken with safety, and with a fair chance of success, from those in which none should be performed. When the tumour, springing from the antrum, is of a simple character, the disease should be removed, together with the whole of the superior maxilla; the tumour, whatever size it has attained, being generally encysted, and the bones expanded around it; so that it is well bounded, and does not implicate neighbouring parts. Here, as Liston justly observes, no nibbling or grubbing operations should be done, but free excision of the whole mass practised. When the tumour springs from the spheno-maxillary or pterygo-maxillary fissure, pushing the bones of the side of the face forwards, I think it is doubtful whether the surgeon ought to interfere, as the base of the skull may be implicated to such an extent that the patient may die a few hours after the operation, as I saw happen in a case of Liston's. When once a malignant growth of this part has passed beyond the osseous boundaries of the antrum, unpleating the soft structures of the cheek, with enlargement of the submaxillary glands, I do not think that it is wise or prudent to interfere with it by operation; as infiltration will have taken place more widely than the knife can reach, and speedy recurrence must of necessity ensue. So long as it is contained within this cavity, where indeed it is often impossible to ascertain, until after removal, the true nature of the affection, it may be excised, provided the glands in the neck be not greatly enlarged. If they be much implicated,

even though the walls of the antrum be not perforated, I think it is safer not to interfere, as a cure by operative procedure must be hopeless. Whenever the soft structures of the cheek are involved so as to require partial excision with the tumour, no operation should be performed; as the disease will probably have become constitutional, cannot be completely extirpated, and will speedily recur in the cicatrix. When the upper jaw on both sides is affected, as sometimes, though rarely, has happened, it is clear that the tumour cannot be removed.

EXCISION OF THE UPPER JAW.—The operation of excision of the upper jaw together with the malar bone for tumour of the antrum, was first proposed by Lizars in 1826; though Gensoul of Lyons was the first surgeon by whom the operation was actually performed, in May, 1829. Extirpation of the superior maxilla, though a serious, is not a very dangerous operation. Of 17 cases, collected by Hutchinson, in which it has been practised in the London Hospitals, it was successful in 14; and of 16 cases (10 of total and 6 of partial resection) performed by Esmarch, 13 were successful (*viz.*, 8 of the former and 5 of the latter). It may conveniently be done in the following way. The central incisor tooth on the diseased side having been extracted, the point of a bistoury should be entered opposite the external angular process of the frontal bone, and carried with a semicircular sweep into the angle of the mouth. From the upper end of this incision, a cut about one inch in length may be carried along the zygoma. Another incision is made from the nasal process of the superior maxillary bone, down to the side of the nose, round the ala, which it detaches, and through the centre of the upper lip into the mouth. The flap thus formed is dissected upwards until the margin of the orbit is reached: the soft parts are then carefully separated from the floor of this cavity, and the infraorbital nerve is dissected out and drawn upwards by a curved copper spatula, which protects it and the globe of the eye. The next step in the operation consists in the division of the bones. This may best be done with strong cutting pliers; the zygoma should be first cut across, the external orbital angle next divided, and then the internal angle cut through by putting one blade of the forceps into the nostril and the other into the orbit. The palatal arch must next be cut across by notching it deeply with a Hey's or a narrow-bladed saw, and then, passing the pliers into the mouth and nose, cutting through the line of the groove and the alveolus of the incisor that had been extracted. The whole mass having had its osseous connections separated, is depressed, drawn forwards, and readily removed by breaking down adhesions with the finger, or by the division of a few remaining soft parts with the bistoury. In the early stage of the operation, during the incisions through the cheek, there is often a good deal of hemorrhage; this may be arrested by pressure, or by the ligation of any vessels, such as the facial, or transverse facial, that bleed with great activity, and, if necessary, by the application of the actual cautery to the bones. However much the soft parts may have been stretched, no skin should ever be removed, as it will all eventually contract. In the later stage of the operation, after the removal of the tumour, there is not so much hemorrhage as might be expected; though some branches of the internal maxillary artery will require ligation. By such an operation as this, the whole of the superior maxillary and malar bones may, if necessary, be removed, and the large cavity that is left between the eye and mouth, having some lint introduced into the bottom so as to support the parts in the orbit and the cheek, may be allowed to granulate; the cheek being replaced and retained *in situ* by a few points of twisted suture evenly introduced through the line of incision in it, and in the upper lip. After cicatrization a coun-

hence, the deformity resulting from such a procedure will be far less than might at first be anticipated.

In some cases, the malar bone and floor of the orbit will be found to be sound. When this is the case they should both be left; and with this view, after the cheek has been turned up, as just described, a deep groove should be made with a narrow straight-backed saw below the orbit, directly across from the nasal process of the maxillary and the outer edge of the malar bone. The removal of the growth may now be effected by cutting through the nasal process with the forceps, and then applying the instrument to the horizontal groove made below the orbit, after which the palatal arch may be divided as already directed.

Fergusson has in some cases succeeded in removing tumours of considerable magnitude by a single incision through the cheek, from the angle of the mouth upwards and outwards; and in other cases by slitting open the upper lip in the mesial line, and then carrying the knife along the side of the base of the columna into the nostrile; by which simple incision, this distinguished surgeon has shown, sufficient relaxation of parts can be obtained to excise the greater portion of the superior maxillary bone.

DISEASES OF THE LOWER JAW.

Tumours not unfrequently spring from the lower jaw. Like those in the superior maxilla, they may either be simple or malignant. Amongst the simple, we most commonly find the *Fibro-cystic*. *Fibrous* tumours are also occasionally met with, and more rarely *Oseous* and *Enchondromatous* growths. The malignant tumours are principally of an *Encephaloid* character. These various growths frequently occur in early and middle life, and usually spring from the diploe between the two tables of which the bone is composed. They project into the mouth and on the side of the neck, forming large rounded uniform, or imperfectly lobed masses. Occasionally malignant diseases spring from the neighbourhood of the bone, and, without invading its structure, envelope it so as to give rise to an appearance of morbid implication of it.

In the *Cystic* and *Fibro-cystic Tumours* of the jaw, the growth is expanded into cysts, having more or less solid matter intermixed, partaking of the character of spulis. These cysts are of various degrees of thickness; some being thin and membranous, others having the walls partly composed of fibrous tissue, and others again having expanded bony lamellae largely entering into their composition, so that on pressure they occasionally communicate the semi-crepitant sensations peculiar to the cystic expansions of the osseous structure. The fluid contained in these cysts is a viscid liquid, usually semi-transparent, yellowish, or bloody.

Diagnosis.—In the lower, as in the upper jaw, it is of great importance to diagnose the simple from the malignant affections; as in the latter form of disease an operation is rarely justifiable, the soft tissues around the bone being usually implicated to such an extent as not to admit of removal, and consequently of the full and complete extirpation of the disease. The malignant tumours may generally be readily detected by the rapidity of their growth, by their pulpy or elastic character, and by infiltration of neighbouring parts, with implication of the submaxillary glands.

Treatment.—The treatment of tumour of the lower jaw depends in a great measure upon the character of the growth. In cystic tumour of moderate size, with thin walls and but little deposit of fibrous tissue around the cysts, the best mode of treatment consists in cutting down on the expanded portion of bone, opening the cyst by means of the antrum-perforator, small trephine,

or cutting pliers, according to its size and the thickness of its walls ; letting out the fluid contained within ; and then, by introducing a plug of lint, causing the cavity to granulate from the bottom, and gradually to contract. When the cysts are so large that they have destroyed the integrity of the bone, or when they are associated with a large quantity of fibrous tissue, so as to constitute true fibro-cystic tumours, excision of the diseased bone must be practised. This, also, is the only plan of treatment that can be had recourse to in other affections of this bone.

EXCISION OF THE LOWER JAW.—The operation of excision of a portion of the lower jaw for tumour of that bone was first performed by Dr. Deadrick of Tennessee, in 1810, and not as is generally but erroneously supposed, by Dupuytren. As the growths for which this operation is performed are usually situated between the symphysis and the angle of the bone, seldom extending beyond the middle line, the operation is generally limited to one side of the face. In some instances, however, the tumour may encroach so far that it may be necessary to remove more than the half of the bone ; and in other cases, again, though of very rare occurrence, the whole of the bone has been disarticulated.

When the tumour is of moderate size, and is situated about *midway between the symphysis and angle* of the jaw, it may be reached by making a semilunar incision of sufficient length under the lower edge of the bone, and carrying the anterior extremity of it well forward upon the chin, but not dividing, if possible, the lower lip, nor cutting into the angle of the mouth ; then dissecting up the flap thus formed, and carrying the knife cautiously along the inner side of the jaw, so as to detach the mucous membrane of the mouth and the mylo-hyoid muscle to a sufficient extent. In doing thus the hemorrhage is often very profuse : the bleeding from the facial artery is particularly forcible, the blood being thrown in a larger and stronger jet than would seem probable from the size of the vessel. This hemorrhage should be at once controlled by the application of ligatures to both ends of the bleeding artery, and to any other points from which it is more than usually abundant. Unless this be done, the after-steps of the operation will be rendered much more obscure and difficult. One of the teeth on each side of the tumour having been previously drawn, the jaw must now be deeply notched through their alveoli into its base with a narrow strong-backed saw, and cut through with pliers, or completely divided with the saw. After the fragment of diseased bone, with the attached tumour, has been removed, and all bleeding vessels have been secured, the flap of cheek should be laid down smoothly, and retained *in situ* by means of hare-lip pins. Occasionally the dental artery in the cut jaw gives trouble ; the hemorrhage from this source may be checked by the application of a piece of solid perchloride of iron. The patient must be fed with slops which should be sucked in through a tube. At a later period, when cicatrization is well advanced, the teeth should be tied together with strong silver wire ; or a silver cap should be fitted upon the teeth of the two portions of bone that are left, and attached by an elastic spring to another silver cap put on those of the upper jaw, so as to prevent the displacement that would otherwise occur in the smaller fragment. Union takes place after a time by fibrous tissue, which becomes sufficiently dense to make the jaw strong and useful.

In those cases in which the tumour *encroaches upon the angle and ramus* of the jaw, it is usually better to remove the bone at the articulation on the affected side, for, if the articular end including the coronoid process be left, it will be displaced forwards and upwards by the action of the temporal and external pterygoid muscles, and be a source of much inconvenience and ulti-

tation to the patient, unattended by any corresponding utility. In these cases, the removal of one lateral half of the jaw will consequently be required, and the operation may be performed in the following way. The point of a strong bistoury or scalpel should be entered immediately behind the articulation, carried down the posterior margin of the ramus behind the angle, and under the body of the bone beyond the anterior limits of the tumour, where it must slope gradually upwards, terminating at some distance from the lips, which should not be encroached upon; the convex flap thus formed is dissected up, and the facial artery and any other branches requiring ligature tied. The knife is then carried behind the jaw in front of the tumour, and, one of the incisor teeth having been extracted before the operation commenced, a saw should be applied to the bone in this situation, and its section finished by means of the cutting-pliers; the surgeon then dissects under and around it; in this situation a scalpel, curved on the flat, will be found useful, the edge of the knife being kept close to the bone and tumour. When he has cleared the tumour and ramus, he depresses the body of the bone forcibly with his left hand, in order more readily to divide the attachment of the temporal muscle to the coronoid process. This having been done, the only part left is the disarticulation, which is best effected by opening the joint from the front, whilst the bone is well depressed and twisted somewhat outwards, the edge of the knife being kept close to its neck, scraping the bone so as, if possible, to avoid wounding the internal maxillary artery, when, any remaining attachments having been cut through, the disarticulation is effected. In depressing the bone to reach the temporal muscle and the joint, care must be taken not to use too much force, lest it happen that the ramus give way, having been weakened by the disease; this accident would produce a good deal of trouble in removing the fragment left behind, which can only be done by seizing it with necrosis forceps, thus dragging it forwards, and then dividing the muscle and capsule. Should the internal maxillary artery have been divided, it must be ligatured, or the termination of the external carotid, where the vessel divides into the temporal and internal maxillary, tied: any other branches that bleed will necessarily also require the ligature. The cavity, having been lightly filled with lint, should then be left to granulate; the cheek being laid down and attached along the line of incision by hare-lip pins and twisted sutures. A kind of fibrous tissue forms in place of the jaw that has been removed, and comparatively little deformity results. When the disease of the bone extends *beyond the symphysis*, a thick ligature should be passed through the end of the tongue, which must be drawn forwards by an assistant, lest on the division of the insertion of its muscles into the lower jaw it be forcibly retracted into the pharynx, and thus threaten or even occasion suffocation, as has happened to surgeons of eminence both in France and in America.

For necrosis of the lower jaw, and the operations for it, see p. 868.

CHAPTER LVII.

DISEASES OF THE MOUTH AND THROAT.

DISEASES OF THE TONGUE.

TONGUE-TIE.—Infants and even adults are said to be *tongue-tied*, when the frænum linguae is shorter than usual, causing the end of the tongue to be depressed and fixed, so that it cannot be protruded beyond the incisors. If this malformation be considerable, suckling and distinct articulation may be interfered with; and then division of the fold becomes necessary, which may readily be done by snipping it across with a pair of round-ended scissors. In this operation, the risk of wounding the ravine arteries that is sometimes spoken of, may be avoided by keeping the point of the scissors downwards towards the floor of the mouth.

PROLAPSUS OF THE TONGUE has occasionally been met with, either as a congenital or an acquired condition; it has been described by Lassus and Crosse as consisting either in a want of power in the retractor muscles, or in hypertrophy of the organ. In this condition, the tongue lolls out of the mouth, is greatly swollen, of a purplish colour, but somewhat dry, with constant dribbling of saliva. If the swelling have existed for a long time, it may give rise to deformity of the teeth, and of the alveolus of the lower jaw, which is pushed forwards. In the *Treatment* of this affection, little can be done unless it be excessive and permanent, when excision of a portion of the tongue by knife or ligature may be required. In children, the ligature would certainly be the safest, as excision might be followed by abundant hemorrhage, not very easy to arrest.

GLOSSITIS is a rare affection, more particularly when it occurs idiopathically; most commonly it results from profuse and injudicious salivation. In this disease the tongue is greatly infiltrated with serum and blood, becoming immensely swollen, so as to hang out of the mouth, with profuse salivation and inability on the part of the patient to swallow or speak, with perhaps a threatening of suffocation.

The *Treatment* is as simple as it is efficient; it consists in making a long and free incision along the dorsum of the tongue on each side of the raphe, which gives free and immediate relief by the escape of blood and infiltrated fluids. I have seen a patient, who was nearly suffocated by the immense size of his tongue, relieved at once, and get nearly well in the course of a few hours by such incisions. Purgatives, especially of a saline character, are also useful; but these cannot be administered until after the swelling has been relieved in the way just mentioned.

ABSCESS OF THE TONGUE, though rare, occasionally occurs. I have seen several instances of it. The abscess forms a small deeply seated elastic but firm tumour, which sometimes feels slightly moveable and presents no superficial discoloration. A boy was brought to me some time ago with an elastic tumour of slow growth, and of about the size of a small plum, situated deeply in the centre of the tongue; on puncturing it, about half an ounce of healthy pus was let out, after which the cyst speedily closed.

NEVUS and **ANEURISM BY ANASTOMOSIS** is but rarely seen in the tongue, and when met with would require to be treated on the same principles that guide us in the management of that disease elsewhere. A very

remarkable instance of an erectile tumour of a nævoid character affecting the tongue came under my care, in which the whole of the free extremity of the organ was implicated in the morbid growth, presenting a thin club-shaped end, which protruded between the teeth and lips of the patient, a girl about three years old. In this case Mr. Image, of Bury St. Edmunds, had very judiciously arrested the activity of the disease, and had produced consolidation of the mass by the introduction of setons, which were worn for some months; and, when the child subsequently came under my care, the chief inconvenience that existed resulted from interference with speech, and the deformity occasioned by the hypertrophied and elongated organ. By means of the *écorseur* I removed all the redundant tissues, and so reduced the tongue to its normal length and breadth.

MORBID CHANGES OF THE EPIDERMIC COVERING of the tongue sometimes occur: amongst the most remarkable of these is *Psoriasis*. In this affection the tongue is indurated, shrivelled, and dry, having cracks upon its surface, with patches of a dead-white colour, and irregular in shape, varying in size from that of a split-pea to an inch in diameter; this condition, exactly resembling psoriasis of the palms of the hands, may occur with or without scaly disease of the general integument. I have seen it in both conditions, and have always found it a most difficult affection to treat. The preparations of arsenic with Plummer's pill and sarsaparilla, have, however, appeared to afford the best results. In some instances it is evidently of syphilitic origin; and then it requires to be treated on the general principles that guide us in the management of the constitutional forms of that disease.

The surface of the tongue occasionally assumes a *Glazed and Warty Character*, as if covered with a layer of boiled sago; the mucous membrane being cedematous, elevated, and papillated, but at the same time glassy and semi-transparent, and without induration. This condition, which usually arises from syphilis, requires the constitutional treatment of that disease.

FISSURES OR CRACKS not uncommonly appear upon the side of the tongue, usually opposite the molar teeth, sometimes dependent on irritation of stumps, but not unfrequently on dyspepsia. These cracks may in some depraved states of the constitution extend rapidly, eroding away a considerable portion of the side of the organ in a short time, so as to leave a large and deep sloughy cavity with much dusky inflammation around it, with great fetor of the breath, and a copious discharge of saliva, which trickles out of the corners of the mouth; the patient being usually destroyed in from three to six months, by the irritation of the discharges, the inability to take food, and the supervention of hemorrhage.

Treatment.—This disease, which is a combination of sloughing and ulceration, is best treated in the early stages by the application of leeches beneath the jaw, and the use of chlorinated gargles, with a moderately antiphlogistic regimen; as it advances, the internal administration of arsenic is useful in some cases, with the application of the balsam of Peru, either pure or diluted with the yolk of egg, and the employment of gargles composed of the chlorides and the tincture of myrrh.

SYPHILITIC TUBERCLE is not unfrequently met with in the tongue, as one of the advanced symptoms of constitutional syphilis, forming an indurated irregularly circumscribed mass, of a round shape, situated deeply in the substance of the organ, or towards the centre of the tip. The surface covering the tubercle is of a dusky red or coppery colour; it rarely runs on to ulceration, though rhagades and fissures occasionally form around it; there is no fetid discharge, and no destruction of the organ.

The *Treatment* consists in the administration of small doses of bichloride of mercury in sarsaparilla, under which the tubercle will rapidly disappear.

CANCEROUS AND CANCEROID DISEASES.—These affections usually commence as epithelioma with tubercles, or fissures, more rarely as scirrhus in a solid mass in the body of the organ; most commonly the disease is situated at the sides, but occasionally the tip is affected. If it appear as a tubercle or warty growth, it is usually flat, indurated, and of a purplish-red colour, gradually running into ulceration; if with a fissure, thus from the commencement has an indurated base, a foul surface, and an everted edge. As the ulceration extends, a chasm with ragged sides, a sloughy surface that cannot be cleansed, and a widely indurated base, gradually form; there is great fetor of the breath, profuse salivation, and, as the disease progresses, implication of the mucous membrane and of the structures of the floor of the mouth, and of the submaxillary or sublingual glands, takes place. The lymphatic glands under the jaw usually become involved at an early period, but I have known the disease to exist for a year or two without their becoming implicated. Cachexy at last supervenes, and the patient dies from the conjoined effects of exhaustion, irritation, and poisoning of the system. In the majority of instances, the disease assumes an *Epithelial* form, but tumours of the tongue may occasionally occur, presenting all the characters of *Scirrhus*. In one instance I have seen cancer of the tongue assume a truly *Encephaloid* character: it was a case in which the disease had twice been removed, and, recurring a third time, assumed the character of a large soft fungating growth, with rapid implication of the floor of the mouth and maxillary glands, death speedily occurring from exhaustion.

Diagnosis.—The diagnosis of these various forms of disease of the tongue is important. The *foul and sloughing ulcer* may be distinguished from all others by the rapidity of its progress, its eroding action, and the absence of all induration at its base. *Syphilitic ulceration*, with an indurated base, commonly closely resembles cancer of the tongue; so closely, indeed, that it is only with great difficulty that the diagnosis can be effected. This, however, may generally be accomplished after a time by observing that the syphilitic ulcer is elongated, irregular, and does not rapidly extend, while the cancerous ulcer is of a circular shape, has eroded edges, and spreads with considerable rapidity. The influence also of treatment will after a time throw light upon the nature of the disease; and the scrapings of the cancerous ulcer, when examined under the microscope, will always reveal its true character.

The diagnosis between the *syphilitic* and the *cancerous tubercle* is most important; here the duration of the disease and the co-existence of constitutional syphilis must be taken into account. It is also of much moment to attend to the situation of the tumour; the syphilitic tubercle being almost invariably met with deeply in the substance of the organ, whilst the cancerous growth is commonly seated at its edges or tip.

Treatment.—In the treatment of cancer of the tongue, therapeutic means are utterly useless. No measures hold out any chance of recovery to the patient, except the removal of the diseased structure; and this it is by no means easy to accomplish, as the cancerous infiltration extends much further than at first appears; passing deeply between the muscular fasciculi into the root of the tongue. This may be effected by either the ligature or the knife. No operation is of any use unless it be carried very wide of the disease, and it should be done as early as possible, before glandular or constitutional infection has come on.

When the free anterior portion only of the tongue is diseased, or when it

is only superficially affected at its back part, the morbid structure may readily and safely be excised; the hemorrhage that ensues, though abundant at the time, usually ceases of itself, or may be arrested by the ligature of the bleeding points, and by the introduction of ice into the mouth. When the organ is more extensively diseased, it has been proposed to divide the lower jaw, and thus to get a view of the whole of the tongue, and to remove as much as proper, treating afterwards the section in the bone as a fracture of it. When, however, the tongue is very deeply diseased, excision is objectionable, as the hemorrhage that follows may be so considerable as to be stopped with difficulty, and, indeed, to require the application of the actual cautery for its arrest. In these deep cancerous affections of the tongue, also, there is usually great enlargement of the submaxillary glands, with infiltration of the floor of the mouth and of the neighbouring soft parts to such an extent as to render it impossible with safety or advantage to excise the diseased mass.

Ligature is the plan to which recourse is usually had; and it is indeed, except where the tip is alone involved, preferable to excision. But, though there is no risk of hemorrhage when this means is used, it is not without objection, on account of the painful nature of the process and its tediousness. Hilton has removed the first objection by proposing and practising section of the gustatory nerve prior to the application of the ligatures. This operation may be done by drawing the tongue forwards and dividing the mucous membrane and submucous tissue vertically for three-quarters of an inch, opposite the molar teeth, over the hyo-glossus muscle, and across the upper portion of the sublingual gland; much venous bleeding usually occurs, which embarrasses the search for the nerve, yet with a little dissection this may be exposed and divided, when sensation will cease in the whole of that portion of the tongue which is anterior to the line of incision. By means of the ligature any portion of the tongue, however deeply seated, may be securely strangled. For the purposes of this operation strong thick saddler's whipcord is the best, as it does not readily cut through the soft and brittle tissue of the organ, which will be the case if the small compressed cord usually sold by the instrument-makers be used.

In removing cancer of the tongue by ligature, the patient should be conveniently seated opposite a strong light. The surgeon then passes a stout doubled silk thread through the tip of the tongue, near the raphe, but somewhat to the side on which he is about to operate; by means of this thread, an assistant draws the organ out of the mouth and keeps it under control; a wooden wedge is next placed between the teeth of the upper and lower jaws, on the side opposite to that on which the operation is to be performed, and the ligature is then passed by means of an ordinary *nævus-needle*, or, what is often more convenient, a corkscrew needle curved on the side as well as to the point (Fig. 325). In many cases, the plan



Fig. 325.—Corkscrew Needle.

described for ligaturing flat *nævi* will be found the most convenient mode of passing the whipcord round the cancer of the tongue (Fig. 326). In whatever way the ligatures are applied, care should always be taken to pass

them through the healthy tissue of the organ wide of the disease, and they should then be tied very tightly, so as to strangle the mass effectually. Great swelling of the tongue, followed by profuse salivation and some



Fig. 326.—Ligature applied to Cancer of Tongue.

fetor of the breath, attend this operation: but the mass, if properly constricted, will slough away in a few days, leaving a large gap that readily fills by granulation. When the disease exists so far back in the tongue that it cannot readily be reached from the

mouth, Cloquet, Arnott, and others have successfully strangled it by making an incision in the hyoid region, between the genio-hyoid muscles, forcing the ligatures by means of long needles through the base of the tongue, and then drawing them tight through the aperture in the neck, so as effectually to constrict the diseased mass.

Regnoli has successfully extirpated large portions of the tongue for cancerous disease of the back of the organ, by making an incision of a semi-lunar shape, along the line of the lower jaw from one angle of the bone to the other; thus opening into the cavity of the mouth through its floor, then making a vertical cut through the centre of this, from the hyoid bone forwards, clearing the parts by a little dissection, and drawing the tongue through the opening down upon the anterior part of the neck, where the diseased structures may be ligatured or excised (Fig. 327). The wound is



Fig. 327.—Regnoli's Operation for removing Cancer of the Tongue.

then closed and united in the usual manner. By this means the surgeon can reach portions of the organ that cannot be got at in any other way. If more space be required, a vertical incision may be made through the centre of the lower lip down to the hyoid bone, the symphysis of the lower jaw cut through with a chain-saw, the mylo-hyoid muscles separated, the tendinous attachment of the genio-hyoid and genio-hyo-glossi muscles divided, and the larynx drawn forwards, when the whole of the organ down to its hyoid attachments will be exposed, and may be removed by the knife or *écarateur*.

This operation, which has hitherto proved fatal in this country, has been successfully performed in two

instances by Fiddes of Jamaica, who has in this way removed the tongue close to the hyoid bone. By dividing and ligaturing the lingual artery, first on one side and then on the other, all dangerous hemorrhage was avoided. After recovery, the patients were found to possess a fair amount of articulation.

The *Ecraseur* has been successfully used by Chassaignac in removing tumours of the tongue that could not otherwise be extirpated. In such

Operations two or more instruments are commonly required, which, as *Thomassinac* represents (Fig. 328), must be passed through the substance of the tongue in opposite directions, so as to isolate and detach the diseased portion of the organ.

In removing large portions of the tongue by means of the *écraseur*, the instrument should be worked very slowly, in order that time may be given for the vessels to contract; but, even with this precaution, hemorrhage will usually occur from the larger arteries to such an extent as to require the application of the ligature.

When, however, the floor of the mouth is implicated in the morbid action, nothing should, I think, be attempted; as it is impossible to extirpate the whole of the disease, and partial removal of it will only be followed by rapid recurrence and increased activity of development. I do not think that slight enlargement of the submaxillary glands should be any bar to the operation, provided the disease be limited, and the constitution good. If enlarged, the glands may be excised together with the disease of the tongue; or, if they be not of very considerable size, they may be left, when they will perhaps subside without the necessity of operation, as their enlargement may probably be dependent upon simple irritation; should they continue indurated, they may readily be removed at a subsequent period.

ENCYSTED, FATTY, and EREMITAL TUMOURS are met with in the tongue, and underneath it in the floor of the mouth.

They require extirpation by the ligature, or enucleation with the handle of the scalpel or fingers, according to their situation and size; and for these irregular operations no special directions can be given. In removing such tumours as these, when situated under or by the side of the tongue, the knife must necessarily be used with much caution. It must, however, be borne in mind that, if these growths cannot be reached from the inside of the mouth, they may be got at by incision through the mylo-hyoid region, where there is but a slight thickness of soft parts between the surface and the floor of the mouth.

Ranula is perhaps the most remarkable of the buccal tumours. This disease occurs under two forms.

1. A globular swelling, semi-transparent, evidently containing fluid, and often attaining the size of a walnut or a pigeon's egg, situated under the tongue, pushes this organ upwards and backwards, and consequently interferes with deglutition and speech (Fig. 329). The walls of the cyst are usually thin, with small vessels ramifying on them; its contents are glairy and serous. This form of *ranula* is usually said to be a dilatation of *Wharton's duct*; but it certainly appears to me that there is no proof of



Fig. 328.—*Écraseur* applied to Cancer of Tongue.



Fig. 329.—*Ranula*.

the disease being of this nature, and, indeed, it is not very easy to understand how so small a duct can be dilated to so large a size as is occasionally attained by these tumours, which seem, in some cases at least, rather to consist of distinct cystic formations, such as commonly occur in connection with other secreting glands.

The *Treatment* of this form of ranula consists either in passing a seton through its walls, so that contraction may take place on this; or else in the excision of a large portion of the anterior wall of the cyst, the remainder contracting, until it at last becomes obliterated.

2. Besides the ordinary form of ranula, an encysted tumour, partaking of this character, is occasionally met with, lying above the mylo-hyoid muscle, between it and the buccal mucous membrane. It projects, however, more distinctly into the neck than into the mouth, and thus forms a large tumour under the angle and body of the lower jaw, soft or elastic, and semi-fluctuating, occupying, perhaps, all the space between the lower jaw and the hyoid bone on one side. It attains the size of an orange. In a case of this kind in a lad of twenty, under my care, the contents of the tumour, which closely resembled cream-cheese in character, were found to be composed of well-formed epithelial scales and much fatty matter.

Treatment.—Such tumours are best treated by making a free opening into them from the mouth, squeezing or spooning out their contents, stuffing the cavity with lint, and allowing it to granulate and contract. If an attempt be made to extirpate them from without, the profuse and perhaps dangerous hemorrhage, the firmness with which the cyst-wall is incorporated with surrounding parts, and the danger attendant on the free use of the knife in the neighbourhood of such important parts as lie between the mylo-hyoid muscle and the base of the tongue, will render such an operation not only unsatisfactory, but hazardous.

DISEASES OF THE UVULA AND TONSILS.

ELONGATION OF THE UVULA.—The uvula occasionally, becoming elongated and hanging down into the pharynx, so as to touch the epiglottis and sensitive mucous membrane in its neighbourhood, gives rise to great irritation

of the fauces, and to a tickling or spasmodic cough, which can only be cured by removing the pendulous body. This little operation may be readily done by seizing the end of the uvula with a pair of polypus-forceps, and snipping it across near the root with a long pair of scissors. It is better not to remove the whole of the uvula. If this be done, throat-irritation is apt to continue. I have been most satisfied with the result of those cases, in which a stump from a quarter to the third of an inch in length has been left. For some years I have been in the habit of using a pair of "vulsellum-scissors" (Fig. 330),



Fig. 330.—Vulsellum Scissors.



Fig. 331.—Polypus Forceps.

which I have had constructed for the purpose, by which the uvula is cut off at the same moment that it is seized, thus rendering the operation easier.

and less irritating to the patient. A very ingenious instrument of American invention, consisting of a pair of forceps and scissors combined, may be employed with the same view; viz., by closing the handles of this instrument the uvula is first seized, and is then immediately cut across (Fig. 331).

TONSILLITIS.—The tonsils are not unfrequently the seat of disease, becoming inflamed or permanently enlarged. When inflamed, they become swollen and red, with much pain in the side of the neck and ear, increased by any attempt at swallowing; there is usually rather a profuse secretion of saliva, and a good deal of swelling under the angles of the jaws; the tongue is much coated with thick pasty mucus, and the voice is thick and nasal. The *Treatment* consists in the application of leeches under the jaw, of fomentations, the inhalation of the steam of hot water, and low diet, which need scarcely be enforced, on account of the difficulty and pain in swallowing. If the mouth can be opened, much relief may be given by scarifying the tonsils with a probe-pointed bistoury; and, if abscess form, it should be opened early, which may most readily be done with a gum-lancet.

HYPERTROPHY OF THE TONSILS.—The tonsils often become chronically indurated and enlarged, sometimes as the result of repeated attacks of inflammation of these parts, but in the majority of instances independently of any inflammatory mischief; though, when once enlarged, these organs are constantly liable to inflammatory attacks. Hypertrophy of the tonsils most commonly occurs as a strumous disease in scrofulous children, who have a tendency to congestion of the mucous membrane of the nose, and to enlargement of the lymphatic glands of the neck. In such cases as these the enlargement of the tonsils may gradually subside as the child grows older and stronger; and I think it well not to be in too great a hurry to excise the tonsils in young children, but rather to adopt a course of constitutional treatment with the view to the improvement of the general health and strength, by means that are ordinarily had recourse to in the management of strumous affections; the internal use of iron and the local application of the tincture of iodine or of nitrate of silver being occasionally serviceable. In the majority of instances, however, the disease will not be influenced by any therapeutic means that may be adopted: and as the enlargement, continuing or increasing, gives rise to difficulty in respiration, and thus interferes with the due arterialisation of the blood in the lungs, and impairs the child's speech, it becomes necessary to remove the projecting portion of the enlarged growth. This may most conveniently be done by means of the ordinary tonsil-guillotine; the ring of the instrument being passed over the tumour, the cutting blade is pushed forwards, and thus a slice of the projecting part of the growth is removed. In some cases not a little difficulty is experienced in getting the tonsil fairly into the ring of the



Fig. 332.—Tonsil guillotine, with Prang.

instrument, more particularly if the child be unruly; this may be obviated by drawing it through with a vulsellum or double hook, and indeed in some

of the machines sold for the purpose a kind of prong is attached, which, being fixed into the tonsil, draws it forwards before it is sliced off (Fig. 332). In performing this operation, especially in children, it is most convenient for the surgeon to stand behind the patient, as he can thus look better into the mouth, and has more command over the head. Should a guillotine not be at hand, the tonsil may be removed by seizing it with a vulsellum, drawing it forwards, and then taking off a slice with a probe-pointed bistoury, the base of the blade of which should be wrapped round with a piece of plaster, to prevent its wounding the tongue. In excising the tonsil in this way, care must be taken to cut downwards and inwards towards the mesial line, and on no account to turn the edge of the knife outwards, lest the internal carotid artery be endangered. The hemorrhage that follows this operation is usually very trifling; but I have known it to be sufficiently abundant to endanger the patient's life. In such cases, ice and gallic acid will usually arrest the bleeding. In one case to which I was called, I found a gargle of spirits of turpentine suspended in mucilage effectual after all other means had failed.

DISEASES OF THE PHARYNX.

INFLAMMATION OF THE PHARYNX of a diffuse erysipelatous character, with low fever, not unfrequently occurs; it is best treated by the application of a strong solution of nitrate of silver, the use of emollient gargles, and the internal administration of ammonia, with bark, stimulants, and support. If it have a tendency to run into sloughing action, the internal administration of the mineral acids, with bark and stimulants, the nitrate of silver lotion and chlorinated gargles are useful. Sometimes abscess forms in the substance of the velum, and then requires to be opened with the knife that is delineated at page 419.

ABSCESS occasionally forms in the cellular tissue behind the pharynx, the posterior wall of which is consequently pushed forwards so as to occlude the posterior nares, giving rise to a peculiar nasal intonation of voice; it also may interfere with breathing by pressing upon the upper part of the larynx. This kind of abscess is often connected with disease of the bones at the base of the skull, or of the upper cervical vertebrae. In many cases, if left to itself, it would burst through the mucous membrane into the mouth; but in others it comes forwards under the sterno-mastoid muscles into the forepart of the neck. By exploring the pharynx with the finger, which may readily be done, tension and fluctuation through its posterior wall may easily be made out.

In these cases the *Treatment* simply consists in letting out the matter by puncturing the tense membrane covering it. This may be done by means of a sharp-pointed bistoury properly protected, or the ordinary abscess-knife. The pus let out is usually offensive, even though the bones be not affected.

TUMOURS are occasionally met with in the postpharyngeal cellular tissue, giving rise to the same swelling, difficulty in respiration and deglutition, and lateral projection, as occur in abscess of this region. These growths are mostly *cancerous*, and speedily prove fatal. *Polyps* in the pharynx usually come down from the nasal cavities, but sometimes spring from the inside of this canal on one or other of its margins. They are usually, when truly pharyngeal, of a malignant character, and grow with great rapidity. The uses of the part are necessarily interfered with, and death may eventually result from obstruction to deglutition and respiration. *Epilethoma* of the pharynx has occasionally been met with. This form of the disease, which is of rare occurrence, does not differ from similar growths elsewhere.

STRICTURE OF THE ŒSOPHAGUS.

All diseases of the œsophagus have a tendency to constrict and eventually to occlude its passage, and hence are commonly described as *Strictures* of it. In some instances the constriction of the œsophagus may be of a purely *nervous* or *spasmodic* character; but in the majority of instances it is the result either of fibrous or cancerous degeneration of the walls of the canal, and is then termed the *organic* stricture. The simple non-malignant or fibrous stricture in most instances eventually degenerates into epithelioma, and hence appears to be more rare than it in reality is, as it is seldom met with after death in its undegenerated form. Scirrhus and œncephaloid growths may, though rarely, develop in and around the œsophagus.

The great feature of œsophageal stricture is difficulty of deglutition; but dysphagia may arise from many causes besides œsophageal stricture. Hence its diagnosis is in the highest degree important.

CONDITIONS PRODUCING DYSPHAGIA INDEPENDENTLY OF STRICTURE.—

There are at least eight different conditions met with in the neck and chest capable of giving rise to dysphagia by compressing the œsophagus, independently of any stricture of that canal.

1. *Tumours connected with the Pharynx.*—Putting out of consideration tumours of the tonsils, which would always be readily discovered, *polypus* of the pharynx may hang down and offer obstruction to the passage of food. In all polypoid growths connected with the pharynx (which are exceedingly rare) the nature, connections, &c., of the growth may be made out by drawing the tongue well forward, keeping it fixed with the tongue-spatula, and passing the finger well down behind the root of the organ; the pharynx can thus be explored, even below the root of the epiglottis, without much difficulty. Abscess may exist between the posterior wall of the pharynx and the spine, possibly arising from caries of the cervical vertebrae; or a *postpharyngeal tumour*, as, for instance, a carcinomatous growth, may be developed from the bodies of the vertebrae, and push the pharynx forwards. The eye is often deceived in these cases, failing to detect the existence of an enlargement at the back of the pharynx; but the finger readily recognises it. In the case of abscess there is fluctuation, and the dysphagia will be removed by opening the abscess and letting out the contents; and the solid or semi-solid and soft, or other feel of a tumour in this situation will lead to a very probable guess as to its nature.

2. *Morbid Conditions of the Larynx.*—Œdema about the back of the epiglottis, or chronic œdema, ulceration, and thickening of mucous membrane there, or œdema about the rima glottidis, may give rise to a tendency for liquids to pass into the air-passages, and thus occasion a serious impediment in swallowing, the difficulty being attended with a feeling of spasm and suffocation. By passing the finger down behind the root of the tongue, the state of parts can often be felt; but the combination of dysphagia with a suffocative fit, and these probably associated with laryngeal cough, are the chief points to be attended to in the diagnosis.

3. *Tumours in the Neck outside the Œsophagus.*—Enlarged glands or a carotid aneurism, developing posteriorly, as has been known to occur with the internal carotid artery; or a tumour connected with the thyroid body, tightly bound down by the sterno-mastoid and fascia, may, by pressing on the œsophagus, give rise to dysphagia. In all cases where that symptom is complained of, the neck should be examined carefully for tumours, which will

generally be very readily detected, especially where the difficulty has existed for some time, and the person has become much emaciated from deficient nourishment.

4. *Aneurism of the Innominate Artery.*—When this disease has risen into the root of the neck it is easily recognisable; but in certain cases it develops first in a direction backwards, and then one of the earliest symptoms is dysphagia. Indeed, the patient may suffer but little from any other symptom, and may apply to the surgeon for relief from it alone, quite unconscious of the existence of any serious disease. The diagnosis will be effected by careful attention to the symptoms described at pp. 619—21. In such a case, much danger might be incurred by at once putting an instrument into the œsophagus, under the impression that stricture existed; for the point of the bougie, or whatever instrument might be used, might perforate the sac of the aneurism, and so give rise to instant death.

5. *Aneurism of the Aorta*, whether of the fusiform or sacculated variety, may give rise to difficulty of deglutition by pressure on the gullet. In this case, also, there is great danger of the aneurismal sac being pierced by an instrument passed down for the purpose of ascertaining the existence of stricture. The presence of the symptoms of intrathoracic aneurism, described at pp. 616—7, will determine the diagnosis.

6. *Intrathoracic Tumours*, such as enlarged bronchial glands, cancerous and other tumours, may be developed from the thoracic spine into the posterior mediastinum, and so compress the œsophagus. In such cases the diagnosis is very difficult. It is difficult enough to determine the existence of a tumour, but still more so to distinguish it from an aneurism undergoing consolidation; but dulness on percussion, and dyspnoea with dysphagia, together with fixed pain in or to one side of the spine, with neuralgia down the arms or up the side of the head, and a varicose condition of the superficial veins of the chest, are the signs on which we place our chief reliance in diagnosing the existence of a tumour. Indeed, in the diagnosis of aneurism of the aorta and of mediastinal tumour, I look upon the combination of dyspnoea with dysphagia, and fixed wearing pain between the shoulders, as of the greatest importance.

7. *Dislocation of the Sternal End of the Clavicle Backwards*, whether merely a simple dislocation, or produced in consequence of excessive curvature of the spine, may give rise to difficulty of deglutition. Of the latter kind there is at least one case on record, which is narrated by Sir Astley Cooper, in which the sternal end of the clavicle by its pressure so obstructed the passage of food, that the patient was brought into a condition of extreme danger. The surgeon, under whose care the patient was, very skilfully and creditably sawed through and detached the sternal end of the clavicle, and thus relieved his patient from the imminent danger in which she was placed.

8. *Impaction of a Foreign Body in the Gullet*—If a man swallow such a thing as a piece of mutton bone, or the settings of artificial teeth, it generally lies across the gullet in such a manner as to be easily felt by the surgeon on passing a probang; but there are other cases in which a foreign body becomes so lodged in the canal as to escape detection and removal. Some years ago I was requested to see a patient who was said to have swallowed a piece of gutta-percha. He had, it appeared, in consequence of having lost several teeth, endeavoured to construct an artificial masticatory apparatus for himself, which had become loose, and he had accidentally swallowed it. A few days afterwards, finding that deglutition continued difficult, he consulted a very able surgeon, who carefully examined him; but, not detecting any foreign body, he considered that the piece of gutta-

percha had passed into the stomach, and that the oesophagus had been scraped by it in its passage down. Inability to swallow solids came on. I saw him months afterwards. The question then was whether the foreign body was still impacted in the oesophagus, or whether the symptoms arose from damage inflicted on that tube. I examined the oesophagus most carefully, but failed, as other surgeons had previously done, to discover the existence of any foreign body. I thought that the oesophagus had been injured in some way, and that probably epithelioma was developing itself, and would, sooner or later, prove fatal. One day, while at dinner, the patient suddenly vomited a large quantity of blood, and fell down dead. On examination after death, we found that the piece of gutta-percha had formed for itself a bed in the wall of the oesophagus, lying parallel with the inside of the tube, and that the ulceration of the mucous membrane caused by its presence had opened some oesophageal vessel—which, we could not ascertain (it was not, however, either the carotid artery or the jugular vein); thus giving rise to the copious and sudden hemorrhage which had caused the patient's death. The surface of the gutta-percha which looked into the oesophagus, being constantly covered and smoothed over by mucus, and being protected, as it were, by a rim of swollen mucous membrane all around it, had allowed the probe to pass easily without its presence being detected.

These, so far as my experience goes, are the eight conditions which are likely to simulate stricture of the oesophagus; and such are the points to be attended to in the diagnosis of these affections from each other. With regard to their diagnosis from stricture, the process is rather a negative than an affirmative one, proving the absence of tumour, aneurism, &c. The conclusion that the difficulty in deglutition can arise from no other cause than stricture is arrived at by a process of exclusion; and the situation and extent of the stricture are ascertained by exploration with a gum-elastic catheter or bougie.

FORMS OF STRICTURE.—There are three forms of this affection which it is necessary to distinguish from each other, inasmuch as they differ greatly in the mode of treatment, and in the ultimate result. These are—1. *Hysterical or Spasmodic Stricture*; 2. *Fibrous Stricture*; 3. *Carcinomatous Stricture*.

1. *Hysterical or Spasmodic Stricture* is met with chiefly in young females under twenty-five, though it may occur in much older persons of the hysterical temperament. The stricture is generally high up in the pharynx, rather than in the oesophagus; being produced by the contraction of the constrictor muscles of the pharynx. The dysphagia is intermittent; when the patient's mind is allowed to dwell long on the affection, and she becomes anxious about it, then the difficulty is greatly increased; whilst at other times, when her thoughts are diverted from it, food passes easily. It will be found also, in these cases, that on attempting to pass a probing or large bougie, its progress will at first be resisted, but, by patiently and gently pressing down upon the stricture, the instrument will soon pass easily.

2. *Fibrous Stricture.*—There are two kinds of organic stricture of the oesophagus—namely, the simple and the malignant—between which the diagnosis is often very difficult; because strictures originally fibrous sometimes degenerate into or assume a malignant form; while others sometimes become fibrous from the first, and others, again, are originally carcinomatous. Generally, on passing an instrument, we find that in the simple or fibrous stricture it passes smoothly, and gives no sensation of roughness, no feeling of lacerating its way, or as if it were passing over an ulcerated surface, no blood follows its withdrawal, and the patient does not bring up pus, or vomit

and blood, though there may be copious mucous discharge. There is no material enlargement in the neck, no swelling of the cervical glands, no sign of the cancerous cachexia.

3. *Carcinomatous Stricture*.—In the malignant or carcinomatous stricture the instrument seems to pass over a rough and ulcerated surface, its introduction is followed by blood, and the patient coughs up blood, or blood and pus, mixed often with shreds of tissue—conditions all indicating a loss of substance (Fig. 333). There is, also, generally, an ovoid or elongated swelling at the root of the neck; the neighbouring glands may be affected; there may be cancerous tumours elsewhere; and the symptoms of the cancerous cachexia may be present. A fibrous stricture may, however, and very commonly does, degenerate into a malignant one—into epithelioma, though, perhaps, not into scirrhus or encephaloid.



Fig. 333.—Carcinomatous Stricture.

CAUSES.—The causes of stricture of the oesophagus are very obscure, indeed inappreciable in the majority of cases. The occurrence of the *hysterical stricture* may, in some cases, be traced to the irritation of a fragment of food, or some pointed body, as a fish-bone, lodging in the throat of a female predisposed to nervous complaints. The *simple fibrous stricture*, when it occurs, may be referred to the cauterisation of the interior of the oesophagus by the accidental or suicidal swallowing of some corrosive liquid, acid or alkaline, by which

the mucous membrane is destroyed, charred as it were, and a cicatrix as of a burn forms. The special causes of cancer of the oesophagus are not known.

TREATMENT.—The treatment of the stricture of the oesophagus will depend upon its nature. In the *hysterical variety*, the occasional introduction of a full-sized oesophagus-bougie, the application of belladonna to the neck, and antihysterical treatment generally, iron, aloetics, douches, and diverting the patient's mind from her malady, are the means to be employed. In such cases, Dr. Garrod has very advantageously employed large doses of *assafoetida*.

The treatment of *organic stricture* is more difficult. In it care should be taken that the patient is principally kept upon nutritious slops, or upon meat that has been well chopped up, as larger fragments are apt to become impacted at the seat of constriction. The difficulty in deglutition will, however, gradually increase, the patient being unable to swallow solids, then being reduced to pulpy food, and at last to liquid. After a time he will not even be able to swallow these; and then it becomes necessary for the surgeon to feed him by the introduction of a gum-elastic catheter through the stricture, and the injection of a sufficient quantity of liquid or semi-pultaceous nourishment into the stomach twice a day. After a few weeks, the irritation induced by the repeated introduction of the catheter will render its passage more and more difficult, until at last it becomes impossible to get it through the constriction. The patient may still be kept alive for some weeks by nutritive enemata, but at last dies of exhaustion and starvation. Even in cancerous stricture of the oesophagus, death seldom occurs by secondary deposits, or by constitutional contamination, but in the way just pointed out.

Such is the miserable course and termination of an organic stricture of the oesophagus. But the question now presents itself, can nothing be done to cure or even to arrest this disease?

The *Palliative Treatment* that is usually adopted in these cases consists in the introduction of bougies, and an attempt to thus dilate the stricture exactly as in the case of a constriction in the urethra. In introducing bougies into the strictured part of the oesophagus, there is, however, often a good deal of difficulty in getting the point of the instrument into the narrowed portion of the canal. This is more particularly the case when the constriction commences suddenly; the oesophagus, as is frequently the case, being dilated into a pouch like sac above it, in which the food is apt to lodge, and the end of the instrument to be arrested, and at the bottom of which a narrow orifice exists, leading into the lower portion of the canal. In these cases much patience and care may be required in overcoming the difficulty. Besides the ordinary dilatation by gradually increasing the size of the instruments used, I have in some cases seen temporary benefit result from the use of a catheter, surrounded by a tube of vulcanized India-rubber, which admitted of dilatation by the injection of water or air when introduced through the stricture; or from the employment of a tubular instrument, by passing a long small-sized bougie through the constriction, and then slipping a gum-elastic catheter with a rounded terminal aperture over it. It is needless to observe that, in the treatment of stricture of the oesophagus with bougies, no force should be used, lest the walls of the canal be perforated.

From these means temporary relief may result in some cases; but can an oesophageal stricture be thus cured? I believe not. If fibrous stricture occurred, as in the urethra, a cure might possibly be effected. But this form of oesophageal constriction, if ever met with, must be excessively rare; and if the disease can be made out to be cancerous, but little good, and most probably much harm, will result from the irritation of dilating instruments. We may, therefore, employ dilatation as a means of temporary benefit, but not with the hope of effecting a cure. Should the stricture at last become so tight as no longer to allow the catheter to be passed, and food to be thus injected into the stomach, the patient must inevitably die of inanition, unless kept alive by nutritive enemata. By these means I have known life prolonged, by a frail tenure it is true, for many weeks. In such cases it is an interesting physiological fact that, although the patients may continue to be moderately well nourished, and do not feel the pangs of hunger, they suffer excessively from thirst.

Has surgery no resource in those cases in which the stricture has become impermeable, and in which neither food can be swallowed nor a catheter passed, and in which, consequently, the most miserable death, that by starvation, is impending? In such cases it has been proposed by Sédillot to open the stomach by an incision through the abdominal walls, and thus directly introduce food into the organ. This operation has been practised several times by Sédillot, Fenger of Copenhagen, Cooper, Forster, and others. Sédillot, who has given it the name of *Gastrostomy*, lays down the following rules for its performance.

Operation.—The patient lying on his back, the surgeon, who stands on the right side, makes a crucial incision, each limb of which is about one inch and a half in length, on the left side of the mesial line of the abdomen, two fingers' breadth to the inner side of the costal cartilages, and about one third nearer to the ensiform cartilage than to the umbilicus; having previously satisfied himself by percussion and palpation that the liver is not in his way. The dissection is carried through the abdominal wall, and the peritoneum is opened. The surgeon then feels with the left index finger for the left border of the liver; by following this upwards, the stomach is reached. This organ is then seized with forceps, drawn forwards, and examined, so that its

identity may be established. By means of three or four points of suture, the anterior wall of the organ is then fixed to the edges of the aperture in the integuments, and an opening is made into it about midway between its two extremities, and a little above the lower margin. Nutritive injections must not be made into the artificial opening for the first few days; not, in fact, until consolidation of the wall of the stomach to the parietal peritoneum has been secured, and a fistulous opening thus fairly established. This must be kept patent by properly adapted silver tubes, through which the nutritive injections are to be made.

The value of this operation has as yet to be determined by experience. In no case in which it has hitherto been done has it succeeded in adding much, if anything, to the prolongation of life. In reasoning upon it, two objections present themselves. First, there is the great and immediate danger of destroying life outright by the induction of peritonitis; though it is by no means impossible that the tendency to abdominal inflammation may be lessened by the previous starvation of the patient. But supposing this risk to be overcome, what is gained by the artificial opening? It is true that through it the patient might be nourished; but, as every idiopathic stricture of the œsophagus is either from the first of a cancerous character, or eventually assumes a malignant action, of what advantage is it to endeavour to prolong a precarious existence, which must in a few weeks or months be cut short by the unchecked progress of a malignant disease? Would not the immediate danger of the operation much more than counteract all good to be eventually derived from it?

There is, however, one class of œsophageal strictures which are of the most obstinate character, and rapidly fatal by simple occlusion of the tube, without any tendency to malignancy. These are the constrictions that result from the swallowing of corrosive liquids, whether acid or alkaline. In such cases as these, in which speedy death by starvation is inevitable, I think that recourse might with propriety be had to the operation of gastrostomy.

DISEASES OF THE LARYNX.

LARYNGITIS.—Inflammation of the larynx principally occurs in adults, from exposure to cold, to the infection of erysipelas, or to the general occasioning causes of the low forms of inflammation. It differs essentially from the croup of children, which is attended by an albuminous exudation, and spreads downwards into the bronchi; whilst in laryngitis, there is no effusion of plastic matter, and the disease is confined to the larynx itself. Laryngitis may not only be of an acute or chronic kind, but it likewise presents two distinct varieties, according to the parts affected, the cause from which it arises, and the condition of constitution in which it occurs: in one, the true *Acute Laryngitis*, the inflammation is chiefly seated in the mucous membrane and cartilages; in the other, the *Edematous Laryngitis*, the affection chiefly occurs in the submucous cellular tissue, within and around the larynx.

In all inflammatory affections of the larynx, whether acute or chronic, there is great danger to life; the rima glottidis, that narrow chink through which all the air destined for respiration must enter, becomes readily occluded, and asphyxia consequently results. This may happen either by the swelling of the lips of the glottis, from the effusion of plastic matter within or upon them, or by the occurrence of spasm in the larynx; indeed, there is always more or less spasm conjoined with all the inflammatory affections of this part of the air-tube; and this spasm, being superadded to already existing mechanical occlusion, commonly proves fatal. These laryngeal spasms do not at first recur oftener than at intervals of half an hour or

an hour ; but as the disease advances they become more frequent, and in any one of them the patient may be carried off. It is of importance to bear in mind that death may occur in these cases, although a considerable portion of the cavity of the larynx continue free. Thus Cheyne states that there are always in croup at least three-eighths of the cavity of the larynx open for the transmission of air ; and that death must consequently result from some other cause than mere mechanical obstruction. This freedom from permanent occlusion commonly occurs in cases of laryngitis ; and the immediate cause of death in the majority of instances appears to be spasm, conjoined with defective arterialisation of the blood, which, becoming dark and poisonous, causes congestion of the lungs or brain, and thus low pneumonia and convulsions.

ACUTE LARYNGITIS.—The *Symptoms* are those of local inflammatory action of an acute kind, conjoined with those of interference with the proper admission of air to the lungs. The cartilages and the mucous membrane are the parts principally inflamed, and but little effusion takes place under the mucous membrane ; hence the symptoms are not always indicative of such early or intense interference with respiration, as is met with in the oedematous form of the disease. In acute laryngitis there are pain and tenderness on pressing upon the larynx, more especially about the pomum Adami. The voice at first is harsh and rough, then stridulous or sonorous ; and deglutition becomes difficult. The difficulty in swallowing is often at first the most prominent symptom, and continues throughout ; dyspnoea, often of a spasmodic character, then appears, the lips becoming livid, the features pale and bedewed with perspiration, the eyes watery and bloodshot, and the respiratory muscles being called into violent action ; the nostrils are dilated ; gasping efforts at breathing, and sudden fits of increased difficulty in inspiring, come on ; at the same time the pulse becomes feeble, though it continues rapid ; and, unless efficiently relieved, the patient will speedily sink. When it proves fatal, the acute usually runs into the oedematous form of laryngitis.

Treatment.—The treatment should be actively antiphlogistic. No time must be lost, otherwise the patient will fall into a hopeless state of asphyxia. Free blood-letting, the application of an abundant supply of leeches to the larynx, and the administration of calomel in large doses, with antimonials, must be employed. If, notwithstanding the administration of these remedies, the difficulty in respiration continue to increase, the windpipe must be opened before the lungs and brain become irretrievably engorged. It is no easy matter to determine when it is no longer prudent to trust to active antiphlogistic treatment, and when recourse should be had to operation ; indeed, the determination of this point may be considered as one of the nicest questions in surgery. As a general rule it may be stated that if, notwithstanding the antiphlogistic means above indicated, the dyspnoea become gradually more urgent, and the paroxysms of spasmodic difficulty of breathing more frequent and severe, then no time should be lost in the performance of the operation, for however short a period the disease may have existed. I can truly say that I have seen several cases lost by delaying the performance of this operation, but never one by opening the windpipe too early. Indeed, if the opening be even made somewhat early, I do not think that much if any harm results, as the larynx is thereby set at ease ; and, on the laryngitis being subdued by the continuance of proper treatment, the aperture, which has simply served as a breathing-hole, may be allowed to close by granulation.

(**OEDEMATOUS LARYNGITIS** is seated chiefly, if not entirely, in the submu-

cous cellular tissue, and frequently comes on in the course of chronic affections of the larynx. It may, however, be of a distinctly erysipelatous character, occurring as the result of exposure to infection, or to atmospheric vicissitudes. In fact, in many cases it appears to be at times epidemic, and in its pathological conditions resembles closely phlegmonous erysipelas of the part; the mucous membrane becoming red, pulpy, and swollen, and the cellular tissue lying beneath it infiltrated with semi-puriform plastic matter. In this form of the disease, the fauces are reddened, dusky, and swollen; there is much and early dyspnoea; the voice becomes hoarse, rough, and speedily extinct; deglutition becomes very difficult; and, on passing the finger over the back of the tongue, the epiglottis will be felt rigid and turgid. There may be some degree of tenderness about the larynx; but the local symptoms, which are less acute, are attended by a greater amount of dyspnoea than in the acute form of laryngitis. In oedematous laryngitis there is also a good deal of spasm associated with the local turgescence. The spasms sometimes come on early, and carry off the patient at once, and are very apt to be brought on by speaking or swallowing; but as the disease advances, the dyspnoea may become more continuous, with great restlessness, a quick, small pulse, and convulsive breathing, the countenance being pale, sunken, and clammy, and the eye dull. Stupor at length supervenes, and speedily terminates in death.

The oedematous infiltration in this form of laryngitis is principally confined to the submucous cellular tissue around the epiglottis, at the margin of the glottis, and to that which lies at the back of the thyroid cartilage. In these situations the tissue is distended with sero-plastic fluid, of an opalescent appearance, so as almost completely to occlude the rima glottidis (Fig. 334).

It is a pathological fact of much importance, that this effusion never extends below the true vocal cords, being limited at this point by the direct adhesion of the mucous membrane to the subjacent fibrous tissue, without the intervention of any cellular membrane.



Fig. 334.—Oedema of the Glottis.

Diagnosis.—It is of great importance to make the diagnosis between the two forms of laryngitis. In the acute variety of the disease, antiphlogistic treatment is of great moment; in the oedematous form it is comparatively useless, for here effusion sets in early, and nothing is left for the surgeon but to open the air-passages, so as to give the patient breathing-room, whilst the disease is being subdued. In making the diagnosis, the epidemic character of the affection, the absence of much pain in the larynx, and the dusky-red and swollen fauces, point to the oedematous variety. Then, also, the effect of antiphlogistic treatment should be taken into account. If, after its active employment, no alleviation of the symptoms occur, it is only reasonable to suppose that the obstruction to breathing is owing rather to a purely mechanical obstacle than to simple inflammation.

Treatment.—The treatment of oedematous laryngitis must be antiphlogistic, though the constitution will not usually bear any very active measures. Leeching under the jaws and over the larynx, the administration of antimonials and salines, will be especially serviceable. In many cases, scarification with a hernia-knife or probe-pointed bistoury about the root of the epiglottis, the sides of the glottis, and the back of the thyroid cartilage, will be found the most ready means of unloading the infiltrated mucous

membrane. In these cases, however, it is especially necessary to open the windpipe before it is too late, and the lungs have become engorged. After the proper employment of the means that have been indicated and their failure, the less delay there is in opening the air-passages through the crico-thyroid membrane, the better. The surgeon should not wait until extreme and continuous dyspnoea has set in; this may never occur, the difficulty in breathing being rather spasmodic than continuous, and in one of the spasms of dyspnoea life may suddenly become extinct. The lungs also may become fatally congested, if the difficulty in breathing be allowed to continue too long. The operation adds but little to the patient's danger, but the increased risk is immense if it be delayed to an advanced period. Not unfrequently this operation is delayed until too late; there is, I think, more risk of doing this than of opening the windpipe too early. When once dyspnoea with laryngeal spasm has fairly set in, every moment is precious, and the patient may at any time be carried off by the recurrence of the spasmodic seizures. The patient does not die gradually asphyxiated, but is suddenly seized with a spasm that terminates his existence.

If the oedematous laryngitis become chronic, sloughing and putrid suppuration of the submucous cellular tissue may occur, as in phlegmonous erysipelas of other parts of the body, and the patient may die partly from asphyxia and partly from typhoid symptoms, with putridity of the breath and mouth. In these cases the administration of stimulants and tonics, more particularly port wine and bark, with free sponging of the part with a strong solution of nitrate of silver, will be urgently required.

CHRONIC LARYNGITIS.—The larynx is liable to various chronic diseases of a serious character, some of which are incurable, leaving a permanent impairment of voice, or alteration in the use of the larynx. These affections present great variety; and, as many of them are attended by loss of voice, they are included under the general term of *Aphonia*. In many cases this affection results simply from cold in relaxed and debilitated subjects, or after long exercise of the voice in persons not accustomed to public speaking. This affection commonly occurs amongst clergymen, and hence is familiarly known as the *Clergyman's Sore Throat*; it is also of frequent occurrence amongst singers, but may be met with among all classes of the community. Aphonia commonly appears to depend upon chronic inflammation of the mucous membrane of the rima glottidis, but is more especially dependent on disease of that extensive mucous surface which stretches from the base of the epiglottis over the back of the thyroid cartilage. In many instances it may also extend into the interior of the larynx, and at last may implicate the vocal cords. In all these situations the membrane is reddened and inflamed, ulcerated at points, and secreting a thin and acrid mucus. In other instances again, the disease implicates the soft palate, the back of the nares, and the neighbouring parts; and in these cases the morbidly inflamed surfaces will be seen to secrete a thick puriform fluid, which usually hangs in a broad streak down one side of the posterior wall of the pharynx.

Symptoms.—The symptoms of this chronic irritation of the mucous membrane in these situations consist of habitual tickling or spasmodic cough, a veiled or hoarse character of voice with, perhaps, at last, complete extinction of it, so that it cannot be raised above a whisper; at the same time there is usually a feeling as if there were some constant cause of irritation in the throat, attended by a desire to cough up and expectorate. As the disease advances, the expectoration becomes more and more puriform, the cough increases, the patient emaciates, is affected with night-sweats, and at last

sinks from what is called *Laryngeal Phthisis*. The neighbouring parts of the pharynx are affected so severe, though they may eventually become diseased downwards.

Diagnosis.—These affections are very frequently bronchitis or catarrhal attacks. From the first by the absence of all auscultatory signs in the pharynx will prevent the disease from being catarrh. This examination, however, requires that a full view may be gained of all the parts engaged is best obtained by means of the laryngoscope brought into view by seating the patient and depressing the root of the tongue at the same time by means of a proper tongue-depressor or spatula to inspire. In order to examine the mucous membrane of the pharynx, and in the neighbourhood of the posterior, may be raised by any convenient instrument.

Treatment.—The treatment of the various diseases of the mucous membrane of the pharynx and larynx is the topical application of a solution of the nitrate of silver almost be looked upon as specific in these diseases.

The practice of treating chronic disease of the throat with a strong solution of the nitrate of silver is by many years ago it was employed by Sir C. Bell and is now applied the solution in these cases by means of a piece of whalebone. Of late years this practice has been recommended by the profession by Trousseau, and especially Horace Green and J. Warren.

Of the great value of this treatment in laryngeal disease, I believe it to be almost impossible to doubt. In chronic inflammatory or ulcerative affections of the throat, to a satisfactory termination by any other means, that is the simplest and most effectual, consists in the application of a proper spatula, and then passing a throat-spatula piece of this material firmly attached to a curved

Fig. 335.—Probang for applying Nitrate of Silver.

and saturated with a solution of nitrate of silver, diseased, so that the liquid may be applied to the surfaces. This solution should vary in strength from one drachm of the salt to an ounce of distilled water; the latter strength will be most useful. This plan of treatment has been practised of late years in this country, and with considerable success in a number of cases. Some of its advocates, however, have objected to this way of disease that is visibly seated in the trachea, as the action extends down the trachea into the bronchi, and it is difficult to follow it in these situations. They accordingly recommend a probang between and beyond the vocal cords, and passing out the interior of the larynx and the lower part of the trachea, applying the caustic solution to them, as if this way could be adopted with as little difficulty as passing the

cannot believe, however, that this practice, though commonly spoken about and professedly employed, is ever in reality carried out. Any one acquainted with the physiology of the larynx knows how acutely sensitive it is, and how it resists the introduction of any foreign body by the most violently spasmodic fits of coughing, in its normal state; and any surgeon who has seen the effects resulting from the fair and complete inhalation of a drop or two of solution of nitrate of silver in a morbid and irritable condition of the tube, must feel sure that no sponge saturated with a solution of this nature could ever have been thrust down between and beyond the vocal cords.

On inquiring into the evidence on which is founded the doctrine of the passage of the sponge-probing through and beyond the vocal cords, I have failed to discover that any of a positive character exists; and, so far as I can gather from the writings of its supporters, it would appear that the reasons from which it is inferred that the instrument thus passes may be arranged under the following heads:—

1. The Sensations of the Patient.
2. The Sensations of the Surgeon.
3. The Analogy afforded by the Introduction of Tubes for the purpose of Artificial Respiration, and by the Inhalation of Foreign Bodies.

These different conditions we must examine somewhat in detail.

1. *Sensations of the Patient.*—The exquisite degree of sensibility possessed by the larynx need not be dwelt upon here. Porter, in his admirable work *On the Surgical Pathology of the Larynx and Trachea*, very justly says, "It (the larynx) is placed as an outwork to protect the important organ of respiration, and rejects vehemently, and with spasmodic violence, every substance that can by possibility prove offensive or injurious." Many years ago, Magendie showed that this was the most sensitive part of the respiratory tube; and in the year 1843 I published in the *Medical Gazette* a series of experiments, which demonstrated the same fact. Since then, I have had repeated opportunities of verifying the correctness of these observations in the human subject in cases of cut-throat and aërial fistula, in which, by means of probes introduced through the artificial opening, I have tested the extreme sensibility of the larynx as compared with other parts of the air-passages, and have often observed the spasmodic irritation and great distress suffered by the patient when its mucous membrane is touched from within; and this, even though the part is no longer subservient to the purposes of respiration, and the sensation of asphyxia is not experienced, which would otherwise be induced, and which would greatly aggravate the distress.

If a long bent probe, or a gum-elastic catheter, be passed over the back of the tongue, two classes of sensations will be elicited, according to the part that is touched. If the instrument be directed down the pharynx, and altogether behind the larynx, into the œsophagus, as in the introduction of the stomach-pump tube, the patient will experience some little distress, which is easily quieted. The face will become slightly congested, and the eyes, perhaps, somewhat suffused, with a disposition to cough, a slight feeling of choking, and some constriction about the chest. All these sensations, however, are transitory. These symptoms may be termed *pharyngeal*.

If, on the other hand, the probe or tube be bent *forwards*, so as to touch the lips of the glottis, and more particularly if an attempt be made to push it on into the larynx, then a widely different train of symptoms will be induced. The patient suffers extreme distress and anxiety; there are great sensation of constriction about the chest and throat, spasmodic difficulty in

breathing, and an inability to speak; the countenance becomes much congested and livid; the eyes protrude, and stream with tears; he stands and gropes wildly with his hands, and is pacified with great difficulty. As the attack goes off, there are deep, sobbing inspirations, and catches in breathing. These symptoms, which are analogous to those induced by irritation of the inside of the larynx through an aerial fistula, may be termed *laryngeal*.

The first class of symptoms is produced by the application of an irritant to the mucous membrane of the pharynx; the second, by irritation of the larynx. Their severity will, in a great measure, depend upon the nature of the irritant applied. They will necessarily be far more severe when a sponge soaked in a caustic solution is thrust down the throat, than when a smooth and unirritating gum-elastic tube is passed.

Both these classes of symptoms are commonly met with after the application of the throat-probang. When the *pharyngeal* symptoms occur, there can be little doubt that no sponge saturated with a strong solution of nitrate of silver has penetrated into the glottis. But is not the case different when the *laryngeal* symptoms are fully developed? Must these not, when existing in their full intensity, be taken as evidence of the introduction of the sponge-probang through the glottis? To this I have no hesitation in answering in the negative. I have repeatedly brought on these symptoms in the most marked degree, without the use of a sponge at all, or the introduction of any solid body into the larynx. In fact, if a drop of a strong solution of the nitrate of silver be fairly inspired into the larynx, the most intense distress and appearance of impending asphyxia will be induced. I once saw this well exemplified at the hospital, whilst applying a strong solution of nitrate of silver, by means of lint wrapped round a probe, to a syphilitic ulcer on the soft palate, altogether away from the larynx; a drop was accidentally inhaled, when the patient was suddenly seized with one of the most intense attacks of laryngeal spasm that I have ever seen; for a few moments she appeared to be about to die asphyxiated, and had all the laryngeal symptoms above described fully marked.

In many cases I am in the habit of applying the solution of the nitrate of silver by means of a strong glass tube, bent nearly at right angles about an inch from one extremity. A few drops of the solution are introduced into the bent end of the tube; and this is passed over the back of the patient's tongue, so as to overhang the glottis, the other end having been closed by the pressure of the finger. The patient, having previously emptied his chest, is then told to take a deep breath; and, at the moment of doing this, the finger being removed from the tube, the solution contained at its bent end is inhaled fairly into the larynx; and, when so applied, it will produce the symptoms already described.

Thus, then, we may conclude that, when the *pharyngeal* symptoms exist alone, the sponge cannot have passed into the true air-passages; and that the *laryngeal* symptoms, however intense they may be, afford no evidence more than the inhalation of a drop or two of the caustic solution into the glottis.

2. *Sensations of the Surgeon.*—That little reliance can be placed on the mere sense of touch in many explorations of the mucous canals, is well known to surgeons. It often happens, for instance, that in the attempt to relieve retention of urine from enlarged prostate, the catheter is supposed to be in the bladder, when it has only reached the dilated sinus of the urethra; so also, in passing a bougie up the rectum, that the instrument appears to have entered the sigmoid flexure, when, in reality, it has curled back upon

itself. Those practitioners, however, who believe in the possibility of passing the sponge-probang beyond the vocal cords, rely much on the sensations communicated by its passage through this narrowed portion of the larynx. They say that, in passing the instrument to the proper depth, a certain sense of obstruction is felt; against this, which is believed to be seated in the vocal cords, the sponge is firmly pressed for a moment, when the obstacle yields, and the instrument passes onwards into the air-tubes. On the withdrawal of the probang, the same feeling of constriction is experienced by the sponge being drawn up against the cords. These sensations are undoubtedly experienced. I have many times felt them myself, and, had I judged by them alone, could have been almost certain that I had passed the instrument between and below the vocal cords, and this belief would have been strengthened by the circumstance that in many of the instances in which this constriction was felt the *laryngeal* symptoms were manifested. I soon found, however, that this was by no means uniformly the case, but that it not unfrequently happened that the *pharyngeal* symptoms only were induced; and that consequently, in accordance with what I believed to be the proper state of sensibility of the larynx, the interior of that tube could not have been traversed by the caustic sponge. Since, also, the same sensation was often experienced in the introduction of bougies and tubes into the œsophagus and stomach, it was clear that it could have nothing to do with their progress through the larynx; and I was led to conclude that it was occasioned by the passage of the instrument through that narrowed portion of the end of the pharynx, or the beginning of the œsophagus, where the cartilages of the larynx, projecting backwards, give rise to a certain amount of constriction, compressing the gullet, as it were, against the spine. Here the instrument meets with some obstruction, which is partly mechanical and partly occasioned by spasm of the constrictors of the pharynx; on this being overcome, it passes on with a sudden slip, again to meet with a degree of constriction on being withdrawn.

In numerous experiments on this point which I have made on the dead body, I have very frequently found that the instrument had passed into the œsophagus, when, from the sensation it gave, those who had introduced it felt confident that it had entered the air-passages. In fact, the shape of the sponge-probang, as it is always sold (Fig. 335), is such that it cannot be made to enter the larynx, and to pass beyond the vocal cords in the dead body, by means of those manipulations which are alone admissible in the living patient, and without the employment of a considerable degree of force. A probang with a short curve, such as those that are uniformly employed, has a natural tendency to take the direct passage, as it were, down the œsophagus, instead of turning forwards to enter the larynx. When the curve is much increased, as in an ordinary catheter, the sponge may, during life, be passed between the lips of the glottis; but it cannot even then be made to pass between and below the vocal cords, in consequence of the curve being too large to be admitted into the diameter of the trachea. The evidence of the New York Academy Commission fully warrants this statement; for the reporters remark that, notwithstanding the most persevering efforts with the whalebone slightly bent, as used by Dr. Green, and with patients who quietly submitted to the test of experiment, the results were entirely negative. In no instance did it enter the trachea. In two instances, with the whalebone curved like a common catheter, the sponge was thought to have entered the larynx; but with repeated attempts it could not be forced between the vocal cords, and the suffocation was so great that it was necessary to withdraw the instrument.

The fallacy of the sensations of the surgeon is well illustrated in the following extract from the report of the Commission of the New York Academy:—"We witnessed in cases 11 and 21 the fallacy of Dr. Green's opinion as to the success of his experiment, though based on so large an experience. In both instances, whilst positive that he had successfully passed the instrument (an elastic tube) into the trachea, the patient *came through the tube*, and thus demonstrated his error."

From these observations, then, I would conclude that the sensations of the surgeon afford no reliable evidence as to the course taken by the instrument.

3. *Analogy afforded by the Introduction of Tubes for the purpose of Artificial Respiration, and by the occasional Inhalation of Foreign Bodies.* Does any such analogy really exist? I think not. It seems to me that a very different degree of irritation would be set up by the introduction of a smooth, well-oiled tube of small calibre, through which the patient can breathe, and from which consequently there is no risk of suffocation, and the passage of a caustic sponge, which not only would stimulate the patient violently, but would necessarily induce temporary asphyxia by mechanically blocking up the air-passage, that no analogy can be drawn from the one case to the other. To do so, seems about as reasonable as to infer that because a gum-elastic or silver catheter may be passed along the urethra therefore a whalebone rod, tipped with a sponge soaked in a caustic liquid, might also be introduced into the bladder.

With regard to the introduction of foreign bodies into the larynx, it appears to me that there is no analogy whatever between this accident and the passage of the caustic sponge. In the one case, the parts are taken by surprise, the foreign body being accidentally sucked into the chest by a rush of air, during inspiration, through an open glottis. In the other case the patient is prepared for what is about to take place, involuntarily and instinctively resists, and, holding his breath, keeps the glottis closed.

But, setting aside this question of analogy, which is of little moment, the introduction of tubes, even into the larynx, so very easy and simple as certain a procedure as some writers seem to suppose it to be! On the dead body, undoubtedly nothing is easier than to pass a catheter into the larynx and down into either bronchus; but is it so in the living? That excellent surgeon, Porter of Dublin, when speaking of the introduction of Desault's tubes through the rima glottidis, in cases of cut-throat, says: "Awkward and reiterated attempts produce inconceivable distress; and, even when performed with the utmost dexterity, it must unavoidably excite cough and restlessness." And again: "Every time the instrument touches the larynx the patient becomes anxious and restless; he tosses himself about, and coughs convulsively; and each motion, whilst it increases his own distress, renders the performance of the operation more difficult. . . . Can such a patient endure the irritation that a few moments' unsuccessful poking at the rima glottidis will inevitably occasion?" The truth of these remarks may be acquiesced in by every surgeon who has ever attempted the operation there described.

On this point, the evidence of the New York Academy Commission is peculiarly valuable. That Commission, in its inquiry, employed two tubes of the size of No. 10 catheter: one, selected by Dr. Green, was slightly bent at its extremity, and was one of the kind employed by him in his practice. The other consisted of a catheter, with a wire stylette, bent with a curve, the segment of a circle six inches in diameter. This tube does not appear to be used in practice, but was employed for the purpose of comparison. It

result of the experiments with these tubes was, that Dr. Green (who was the only one that employed it) failed in passing the tube with the *small* curve in thirty-five out of thirty-eight trials, or in about ninety-two per cent. of the cases, and that the tube with the *large* curve was passed in eight cases out of thirteen; whilst the sponge-probang failed in every case (eighteen) in which it was tried.

"From these experiments it would appear that the instrument best adapted to succeed in catheterism of the air-passages is the tube having a large curve; whilst the least adapted to enter the trachea is the sponge-probang."

In the course of these experiments a point of much interest was elicited by the Commission,—viz., that a patient might blow out a lighted candle, or collapse and inflate a bladder attached to its free extremity, through the tube, even though it had never entered the trachea, but had been purposely passed into the œsophagus. This observation I have more than once confirmed at the hospital in the treatment of stricture of the œsophagus: for, on introducing a catheter through the stricture, air is sometimes sucked into the stomach, and then expelled through the catheter with sufficient force to blow out a lighted candle, by the action of the abdominal muscles alone.

On this third point, then, I think we are warranted in the conclusions, that there is not sufficient analogy between the introduction of the sponge-probang and that of a catheter tube into the larynx, to lead us to suppose the passage of the former instrument possible, because that of the latter is occasionally practicable; that the introduction even of a tube of the same shape as the sponge-probang is an operation of extreme difficulty, failing in far the greater proportion of cases in which it has been attempted, and that the introduction of foreign bodies into the larynx is effected under totally different conditions from that in which the sponge is attempted to be passed.

Finally, I think that we are fully justified in adopting the conclusion of the Commission of the New York Academy, that there is no reliable evidence that the sponge-probang has ever been passed through and beyond the vocal cords.

Inhalation of the nitrate of silver in powder is most conveniently done by mixing it, in proper proportions, with some innocuous impalpable powder, such as ground and dried sugar. The strength may vary, from one part of the nitrate of silver to twelve, sixteen, or twenty of the sugar. A small quantity of the powder so prepared should be put into the end of a thick glass tube, which has been bent nearly at right angles, about one inch from its extremity. The surgeon, placing his finger over the orifice of the straight part of the tube, carries the bent end behind the tongue, over the epiglottis; he then directs the patient to make a sudden inspiration, and at the moment of his doing so takes away his thumb, so as to allow the powder to be drawn out of the tube and into the air-passages along with the current of inspired air. In this way the nitrate of silver may, in some cases, be very conveniently applied to the whole of the affected mucous surfaces without the irritation produced by the friction of the sponge.

Injection of the solution of nitrate of silver may easily be done by means



Fig. 336.—Laryngeal Syringe

the instrument that is here delineated (Fig. 336), and which I have had

constructed for this purpose. It consists of a rod and, and having a small piston moving in it with its lower surface. The instrument is charged by dipping the rod and then drawing back the piston-rod. It is then used either between the lips of the glottis, and the flux passages or upon the inflamed surfaces in a more direct manner, pushing down the piston and compressing the fluid. In the *laryngeal syringe* the nitrate of silver can be applied to the pharynx, without irritating the tender mucous membrane; and, by applying its nozzle to the glottis, the fluid may be readily thrown down into the larynx with the greatest certainty and ease. In those cases where it is necessary to apply the solution of the nitrate of silver to the inflamed surfaces, using this simple instrument to the ordinary syringe, which upon a tender mucous surface may be a source of irritation, the mucous membrane behind the velum, or the epiglottis, the solution may readily be applied to the end of the instrument upwards, and then injected into the affected surfaces.

In whatever way the caustic is used, its application should be repeated about every second or third day, in order to insure its effect. In some instances, however, advantages may be obtained by using others, again, a longer interval is required than in the first.

RESULTS OF CHRONIC LARYNGITIS.—In the chronic disease of the larynx, the mucous membrane is covered with *Plastic Deposits*, which also form upon its surface, and at last run into *Ulceration*, with a mucous and muco-puriform discharge. These diseases have their origin, and, after continuing for some length of time, lead to dyspnoea, cough, shortness of breath, a pale, pasty, and swollen face, with suffused eyes and constant distress. In these circumstances there is a constant tendency to the supervening of the chronic laryngeal disease; and, if not relieved, proves fatal by the induction of oedema of the glottis with great rapidity.

Necrosis of the Cartilages of the Larynx not only presents more advanced forms of this affection, attended with constitutional and local, of the so-called *Laryngeal* exudation of large quantities of fetid puriform blood, and occasionally containing masses of the cartilage. In many cases *Abscesses* form outside the larynx, causing irritation and distress open externally; and not only with to such an extent, as to undermine and destroy the tissues of the anterior part of the neck, but, when the necrosed patches of cartilage, they give rise to the formation of which bubbles of air escape during respiration.

Treatment.—In the treatment of these more advanced forms, the daily application of nitrate of silver will be found to be of great service. It should be freely applied to or injected upon the inflamed surfaces, within the lips of the glottis, and more especially upon the mucous tissue which is extended over the back of the larynx, which is commonly the seat of much chronic irritation of the muco-puriform discharge. At the same time, the use of bichloride of mercury with care should be attended to.

great service, more particularly in those cases in which the disease is of a syphilitic character; the patient being kept in a regulated temperature, not allowed to exert his voice, and avoiding all laborious exertion. Whenever acute inflammation supervenes in these cases, with a tendency to œdema about the glottis, the patient should be narrowly watched, as he may readily be carried off by the sudden swelling of the lips of the rima, or by the super-vention of apœam. In cases of this kind, the air passages may require to be opened to allow respiration to be carried on; and this operation must not be delayed until such time as the patient falls into an asphyxial condition.

NERVOUS AFFECTIONS OF THE LARYNX occur both in children and in adults. In *children*, the affection, commonly called *Spasmodic Croup*, comes on suddenly and runs its course with great rapidity. The child is seized, often without previous warning, with difficulty in breathing, uses violent efforts to inspire, becomes black in the face and convulsed, and may die before anything can be done for his relief. In other instances he gapes and gasps a few times, and eventually recovers himself with a long deep-drawn whooping inspiration. In cases of this kind, the *Treatment* at the time of the fits consists in dashing cold water in the face, in exposing the body to a current of cold air, and in using friction to the extremities. If asphyxia occur, artificial respiration must be kept up either through an opening made in the windpipe or by the mouth.

In the *adult*, these spasmodic affections of the larynx may come on either from pure hysteria, or from irritation of the laryngeal nerves by the pressure of tumours or aneurisms upon them. In other instances they arise from the presence of some local inflammatory mischief about the glottis. In the hysterical form of the affection the ordinary remedies for hysteria, together with cold douches, will be of essential service. In some cases, however, the obstruction to respiration is so great, that the surgeon may almost think it necessary to have recourse to operation. When the disease arises from irritation to the trunks of the nerves, such a procedure is seldom justifiable, as the occasioning cause is usually in itself of a fatal character.

TUMOURS OR POLYPI occasionally form in the larynx. They are commonly granular, or small cauliflower-looking bodies, though they occasionally attain the size of a hazel nut. In structure they are usually epithelial, occasionally fibrous, and eventually may become canceroid (Fig. 337). They necessarily produce aphonia, interfere with respiration, and at last may give rise to asphyxia by obstructing the cavity of the larynx.

These tumours, which formerly could neither be recognised with certainty during life, nor treated effectually, have often of late not only had their existence demonstrated by means of the laryngoscope, but have been removed by Dr. Walker of Peterborough and Dr. Gibb, in this country, and by M. Moura-Bouroullou in Paris. Dr. Gibb, in cases of this kind, has succeeded in passing a loop of silver wire round the bases of two such growths, lying just within the true vocal cords, and then detaching them by drawing the wires through a steel cannula, and so tightening the loop. This ingenious operation has been performed several times with the aid of the laryngoscope. Dr. Gibb tells me, that the operation is much facilitated by first administering full doses of the bromide of ammonium, which has the property of suspending the sensibility of the pharyngeal mucous membrane.



Fig. 337.—Epithelioma in Larynx.

CHAPTER LVIII.

PLASTIC SURGERY OF THE FACE AND MOUTH.

By *Plastic or Reparative Surgery* is meant the performance of operations for the repair of deficiencies in structure, whether resulting from injury, from disease, or from malformation.

It has been long known that parts of the body may retain their vitality sufficiently to become again adherent, when attached but by a very narrow tongue of tissue to the part from which they have been all but separated. This has often been observed in cases of injuries of the face and fingers, portions of which have been nearly completely severed, and yet have united again on being replaced. But there are even a sufficient number of cases on record to show that certain parts, when completely separated, may, after being replaced, again become adherent. The most remarkable instances of this kind are those which are related by Dr. Hoffacher, and attested by Chelius and Velpeau. Dr. Hoffacher was officially appointed to attend a surgeon at the duels which were at one time frequent amongst the students at Heidelberg; and, as at these encounters broad-swords were used, he had an opportunity of seeing a considerable number of incised wounds, and has related no fewer than sixteen cases in which portions of the nose, lips, or chin had been sliced off, and, being put on again, contracted adhesions. Amongst the most remarkable of these, is a case in which the end of the nose was sliced off by a cut with the broadsword, and fell under a chest of drawers; it was not found for some time, but on being recovered and washed, was stitched on, and became firmly attached. In another instance, a dog that was in the room snapped up the detached portion of the organ as it fell to the ground, but the nose, being immediately taken out of the animal's mouth and put on again, became firmly fixed!

In order that union should take place between parts that have been separated completely or nearly so, and the rest of the body, it is necessary that they be soft and vascular, and more especially that their structure be of a homogeneous character, such as is met with in the tissues of the face; where no very large bloodvessels, nerves, tendons, or bone are found. It is the same in plastic operations, which succeed best under similar conditions of tissue, and which are conducted on the same principle as an attempt at union in a partially severed structure.

It is principally for deformities and loss of the nose and lip that plastic operations are of much service; they may, however, occasionally be had recourse to in other situations, as about the cheeks and eyelids, but seldom with an equal amount of success. Reference has already been made (p. 412) to the performance of plastic operations on the perineum. In the practice of this very interesting branch of surgery, there is much opportunity for the display of manual dexterity. On this, indeed, almost the whole success of the operation depends; and a vast deal may be done in apparently the most unpromising cases by management, skill, and patience. In these operative procedures the names of Serres, Dieffenbach, Liston, Fergusson, Sedillot, B. Langenbeck, and Jobert, deservedly take the first rank.

In performing the various plastic operations, four methods have been employed. In the first, the flap of skin that is intended to repair the lost structure is transplanted from a distant part, as the arm. This operation

which was introduced by the Italian surgeon, Tagliacotius, and hence commonly called by his name, has in a great measure fallen into disuse, on account of the difficulty of its execution, and the great uncertainty of obtaining a successful result. The second plan consists in transplanting the reparative structure from some part in the neighbourhood of the organ to be repaired; the skin from the forehead, for instance, being used for the formation of a new nose; that from the chin for the restoration of a lost lip. This procedure, which seems first to have been adopted by the natives of India in restoring the loss of the nose, is the method that is most commonly employed in this country in plastic operations on the face. The third method consists in loosening the skin by a process of subcutaneous section to some distance around the part to be repaired, and then drawing it forwards with or without incision through its substance. This gliding operation is chiefly practised for the closure of fistulous openings. The fourth method is employed in cases where an abnormal fissure exists in a part. It consists in bringing together and uniting the edges of the fissure, after having pared them evenly, so as to expose their vascular surfaces.

Union in plastic operations is affected by primary adhesion between the raw surfaces which are brought into contact. Should, however, this mode of union fail from any accidental circumstance, the surgeon need not despair; as the parts may unite by adhesive inflammation, or even through the medium of granulation, in a very satisfactory and complete manner.

For proper union to be effected, it is necessary that the edges be cleanly and evenly cut, so as to adjust themselves accurately to one another. This may often be most skilfully effected by making the incision in the part that is to receive the flap somewhat oblique or bevelled, thus securing a more accurate adaptation of the edges.

After the flap has been formed and the part in which it is to be transplanted properly pared, the operation should be delayed a few minutes until all bleeding has ceased. This is of much importance, as the interposition of a layer of coagulated blood will materially interfere with union.

In bringing the parts into apposition, great care must be taken that no undue traction or constriction be exercised, lest their circulation be interfered with, and their vitality be endangered.

The parts may be maintained in apposition by sutures, collodion, or the application of a strip of isinglass plaster. The sutures should be as fine as possible, introduced with a small needle, and knotted on the sound parts. Occasionally, as in hare-lip, pins may advantageously be used. In some instances, instead of sutures, a small spring-forceps (Fig. 53), termed a *serrefine*, may be employed, but most generally interrupted sutures are the best. The use of collodion, where applicable, is of great advantage in plastic surgery, as it not only secures adhesion, but, by excluding the air, lessens the chance of suppuration.

For a plastic procedure to succeed, it is absolutely necessary that no morbid action be going on in the seat of operation; and not only that none be actually in progress, but that all have ceased for some considerable time. This is more particularly the case when the deformity for the remedying of which it is practised has resulted from syphilitic or cancerous ulceration. In both cases it is necessary to see that the constitution is sound, as well as that all local disease has been eradicated; otherwise the irritation of the operation might set it up again, and the new flap might be invaded and destroyed. From want of this precaution, I have more than once seen disappointment result. When an operation, as on the nose or lip, is performed for cancerous disease, ablation of the morbid part may be done at the moment

of operating—the affection being a local one; when for struma or syphilis the disease is constitutional, and care must be taken that all morbid action has thoroughly and completely ceased. As a general rule, plastic operations practised for the repair of mutilations from injury, or of congenital deficiencies, are more successful than those that are performed after disease.

No routine system of treatment should be adopted; but a few days of rest, good diet, and a dose or two of aperient medicine, may be prescribed before the operation is proceeded with. In the after-treatment of the case, a nourishing but unstimulating regimen should be observed.

PLASTIC SURGERY OF THE EYELIDS.

BLEPHAROPLASTY, or the operation by which the eyelids are repaired, is occasionally required for loss of substance—the result of wounds, cicatrices, or operations. It is less satisfactory in its results than most of the other plastic procedures about the face; yet it may, in some cases, improve materially the patient's appearance.

When the upper eyelid requires repair, the flap is taken from the forehead; when it is the lower lid, from the cheek or temple. This operation may be performed either by the gliding method, or by twisting a flap into its new situation. By the gliding method, a triangular flap is cut and partially detached (Fig. 338 a), and then drawn gently

Fig. 338.—Operation for Repair of Eyelid. (a) Gliding Method; (b) Twisting Method.

forwards until it corresponds to and fills up the gap that requires repair, when it is there fixed by a few points of suture. When the twisting method is employed, an oval flap is detached (Fig. 338 b), except its pedicle, and twisted down, to be planted on the raw surface.

Occasionally neither of these methods is applicable; and then the procedure, that was successfully adopted in a case of which the annexed cut (Fig. 339) is a representation, may be adopted. Here there was a deep and



Fig. 339.—Lower Eyelid deformed by Cicatrix.



Fig. 340.—Lower Eyelid after Operation.

hard cicatrix across the lower eyelid, causing eversion of its outer portion, and adhesion of the inner part to the ball of the eye. After dividing the adhesions and removing the cicatrix, I made a semilunar incision so as to dissect up the eyelid, and then fixed it by points of suture in its new situation, where it became firmly adherent (Fig. 340).

Operations of various kinds are frequently performed on the eyelids, which are truly of a plastic character.

SYMBLEPHARON.—In symblepharon, or adhesion between the lid and the eye-ball, the adherent portion of lid may be included between V-shaped incisions and removed, and the edges of the cuts brought together (Fig. 341 a).

EPICANTHIA.—In epicanthis, or projection of the nasal fold of the eyelids, an elliptical portion may be removed parallel to the nose, and the edges of the incision brought together with sutures.

PTOSIS.—In ptosis, or drooping of the upper eyelid, an oval portion of the lid may be raised horizontally, and removed so as to leave an oval gap (Fig. 341 b); the edges of which being brought together will lessen the depth of the lid, and thus diminish the deformity.

ENTROPION.—In entropion, or inversion of the eyelid, the same operation may be practised, and thus, by the contraction of the cicatrix, the tendency to its turning inwards lessened. But various other procedures are at times required in order to remedy this deformity. Thus a vertical instead of a transverse flap may be removed; or Crampton's plan may be followed, which consists in making a vertical incision through the whole thickness of the lid, near each angle (Fig. 342 a), and then removing a transverse fold of the skin, bringing the edges of that wound together in the usual way. This operation is chiefly applicable when the tarsal cartilage is contracted and, as it were, shortened. Lastly, when the tarsal cartilage is much contracted and inverted, the whole edge of the lid may be removed by passing a Beer's spatula between it and the ball, and then cutting upon it.

ECTROPION.—In ectropion, or eversion, the lid may be well everted, and a portion of the conjunctiva raised with a pair of forceps and snipped off. This operation, however, seldom succeeds; and it is usually better to remove a wedge-shaped portion of the lid, of a size proportioned to the amount of eversion; or Dieffenbach's method may be tried, which consists in making a transverse incision through the lid down to the conjunctiva, seizing this, drawing it forwards until the lid is restored to its proper shape, then removing the projecting fold, and bringing the edges of the incision together in the usual way (Fig. 342 b).



Fig. 341.—Operation for (a) Symblepharon; (b) Ptosis.



Fig. 342.—Operation for (a) Entropion; (b) Ectropion.

PLASTIC SURGERY OF THE NOSE.

RHINOPLASTIC OPERATIONS occasionally require to be performed for the restoration of the form of the nasal organ, which has been destroyed by injury or disease. This branch of plastic surgery has long received much attention, and has been reduced to distinct rules. Either the entire nose, or a portion, may demand operation.

COLUMNA.—When the columna and a portion of the septum are destroyed, a large gap is left at the nasal aperture; and, the nose becoming flattened in consequence of its tip falling in, great deformity necessarily results. The upper lip also, losing that amount of support which it receives from the columna, becomes pendulous, projecting, and thickened at the end, thus adding to the disfigurement. The restoration of the columna is effected from this thickened and prominent upper lip, which, by being reduced in size, is rendered far more shapely. The operation consists in cutting through the

whole length of the lip from above downwards on each side of the mesial line, so as to leave a tongue about one-third of an inch in width. This is then turned up; and, its end being well pared, and the under surface of the tip of the nose properly vivified, it is fixed by means of a fine hare lip pin and twisted suture, which should be left in for about four days. Union takes place in a few days; but, until this is firm, the new columna must be properly supported with narrow strips of plaster fixed to the cheek on each side. No twisting of this small flap is required, as the mucous surface speedily becomes cutaneous, and *vice versa*. The division in the upper lip must be treated in the same way as an ordinary hare-lip, and unites without difficulty, lessening greatly the deformity in this part.

ALA.—When one ala only is deficient, the rest of the nose being sound, a flap of skin of the proper shape to restore the deformity, having been raised from the cheek, may be applied to the previously pared edges of the part requiring it, and fixed there by a few points of fine suture. If the loss of the substance of the ala be very considerable, or if it extend to a part of the body of the nose, then it is more efficiently restored by bringing a long narrow flap from the forehead in a way that will immediately be described. In the majority of cases the destruction of the ala and of the body of the nose is so considerable, that other plans, to be presently described, are required for the repair of the deformity.

NOSE.—For the restoration of the entire nose, two procedures have been employed: viz, 1, the Tagliacotian Operation; 2, the Indian Operation.

1. The *Tagliacotian Operation* consists in taking the integument and cellular tissue required for the repair of the lost organ from the inside of the arm. Here a flap of sufficient extent is to be marked out and dissected up with its subjacent cellular tissue, leaving it merely attached to the limb by a root at its distal end. No attempt at fixing this flap to the nose should be made for at least a fortnight, during which time it should be kept upon a piece of wet lint, and allowed to thicken, granulate, and become vascular, so as to fit itself for adhesion to the new surface to which it is to be applied. The remains of the deformed nose having then been properly pared and the flap shaped, they must, after all bleeding has ceased, be properly adjusted and fixed to one another by points of suture. The arm must then be closely attached to the head, so as to be as nearly as possible immovable. At the end of about ten days, when adhesions have taken place, the connecting medium may be cut across, and the part left to be supported by the vitality which it may gain from the new surface to which it is now attached. This process is comparatively seldom had recourse to, for obvious reasons. The uncertainty of maintaining the vitality in the flap, the extreme tediousness of the prolonged constrained position in which it is necessary to keep the patient, and the great difficulty of guarding against movements of the arm, especially during sleep, and which, however slight and involuntary, would be sufficient to disturb union between the opposed surfaces, and occasion the failure of the operation, have caused this plan of procedure to fall into disuse; and it is now, I believe, universally abandoned by surgeons in this country, having been replaced by the more certain procedure, which will now be described, of borrowing the skin for the new nose from the forehead.

2. The *Indian Operation*, a knowledge of which was brought to this country by Carpué in 1814, is extremely successful in its results, though requiring a good deal of nicety for its proper execution. The operative procedures required by this method are somewhat complex, and may con-

veniently be divided into three distinct periods; 1, the Dissection of the Flap from the Forehead, and its Attachment to its new situation; 2, the Separation of the Root of the Flap where it is turned down from the forehead, and the Formation of a proper Bridge to the Nose; 3, the Formation of the *Columna Nasi*.

1. *Formation and Attachment of the Flap.*—In the shaping of the flap, care must be taken that it is of sufficient size; as during the after-part of the treatment it often has a tendency to shrivel, and more inconvenience usually results from its not having originally been made large enough, than the reverse. The size adapted to the particular face may best be judged of by moulding a thin piece of gutta-percha to the nose, then flattening it out by dipping it in hot water, and using this as the guide

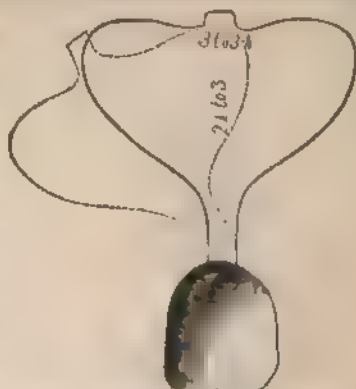


Fig. 343.—Diagram of Flap in Rhinoplasty Operation

for marking the outline of the flap upon the forehead. This should be traced with tincture of iodine, which will not be washed off so readily as ink by the flow of blood, which is often rather free. This flap should be of the shape in Fig. 343, taking care that it is rather square at the angles, and not too much rounded off. The size will necessarily vary according to the character of the countenance, and the extent of loss that has to be repaired. When the whole of the nose requires restoration, it is usually necessary to make it about two and a half to three inches in length, by about the same in width at the broadest part. It may either be taken from the middle of the forehead, or obliquely from one side: if the latter, the right side is the most convenient. It must now be dissected off the forehead; in doing this, care must be taken not to remove the pericranium, but at the same time to cut the flap as thick as possible, especially at its root between the eye-brows. It must also be but little handled, and, above all, not pinched, either with fingers or forceps. The dissection should be commenced at the root, so that the outline may not be obscured by blood; and this part should be left long, in order to admit afterwards of a very gradual and easy twist. In order to facilitate this, it is also desirable to make the incision on the right side a little lower than that on the left. After the flap has been raised throughout the whole of its extent, a piece of wet lint should be applied to the forehead, with a view of arresting the bleeding, before the next step is taken. This consists in paring the surface and edges of the stump of the nose, and removing the integuments from it in such a way as to leave a triangular raw surface. In doing this care must be taken—whilst a good base of attachment is left—not to remove the parts too widely, lest the cheeks, by separating, have a tendency to gape too much, and the nose to become flattened out. The integuments also should be dissected away in such a manner as to form a deep groove shelving inwards, so as to receive and hold the flap more securely and with less overlapping of the edges. The operation must now be discontinued for a few minutes until all bleeding has ceased, and the cut surfaces have become glazed; this point is of great importance in securing direct adhesion, and must be carefully attended to. The bleeding having been arrested by exposure to the air, and by the torsion rather than the ligature of any spouting branch, the flap from the forehead

should be brought down by a twist from left to right, and attached by a few points of fine suture on each side to the edge of the incision, around the nasal aperture. A pledget of soft lint, moderately greased, should now be gently insinuated under the flap, the lower part of the incision in the forehead drawn together by a point of suture, but not so as to constrict the root in any way, and the rest of the exposed surface covered with water-dressing. The parts will then present the appearance of Fig. 345, taken from



Fig. 344.—Depressed Nose.



Fig. 345.—New Nose, day after Operation.

patient of mine the day after the operation. Fig. 344 represents the deformity for which the operation was performed. The patient should be put to bed with a piece of soft lint laid over the whole of the face, so as to maintain its temperature; and, if it be winter, he must be placed in a room that is kept well warm day and night. The diet for the first few days should be simple, but abundant, consisting chiefly of nutritious slops.

The dressings must not be disturbed for three days: by this time, if all go well, the flap will be found somewhat tumid, warm, and sensitive, but pale in colour. The plug in the nose will now require changing, lest it be rendered offensive by the discharges; its withdrawal and the substitution of another must be done with the greatest gentleness, the surgeon bearing in mind that any undue pressure or traction may destroy adhesions, and prove fatal to the vitality of the flap. If the sutures produce no irritation, they may be left in till the fifth or sixth day, by which time the adhesions will be tolerably perfect, and they may with safety be cut and withdrawn. As the adhesions strengthen and the vitality of the flap improves, it must be elevated by putting underneath it a larger plug of lint; for which, after a time, may be substituted a small gutta-percha tube moulded to the figure of the inside of the nose. (Edema of a somewhat solid character is apt to come on in the flap, giving it a white appearance; but this is of little moment, and will gradually subside as the circulation through it becomes more actively established. The flap gradually becomes thicker and firmer, throwing out granulations from its under surface, which eventually becomes clothed with mucous membrane. The wound in the forehead must be dressed like an ordinary ulcer, and be well touched with nitrate of silver from time to time, to insure its contraction. It usually cicatrises with great readiness, and leaves remarkably little deformity.

2. *Separation of the Root of the Flap.*—This may be done about a month after the flap has been fashioned, when its vascularity, through its lateral adhesions, will be perfected. The division of the root is best done by passing a narrow-bladed bistoury under the twist, and cutting upwards towards the eyebrows, removing a wedge-shaped portion of the soft parts, so as to make a smooth and proper bridge.

3. *Formation of the Columna Nasi.*—The addition of the columna is now all that is wanted to make the nose complete. This must be made from the upper lip, perhaps at the same time when the bridge is fashioned, and may be cut and fixed in the way that has been already described in speaking of the restoration of this feature, the interior of the apex of the new nose having been well pared to receive it. The columna requires to be well supported by means of a narrow strip of plaster passing from one cheek to the other, and usually requires a good deal of fashioning before it is perfect; indeed, this is the part of the operation that I have found always most troublesome, and requiring most attention.

The new nose must continue to be supported from beneath, for some months after its formation, by plugs of lint or small gutta-percha tubes, as it will evince a great tendency to contract and to alter in its general outline and shape; becoming, if the surgeon be not careful, either depressed or dumpty. The sensibility of the new nose is entirely destroyed for a time after the division of the bridge; but it slowly returns from all sides, appearing first in the neighbourhood of the adhesions between it and the cheeks, then near the columna, next in the bridge, and thus the organ at last has its sensation restored; for this, however, several months will usually be required, and the part in which it returns last of all is its central portion. The annexed cuts (346, 347) give a very faithful representation of a



Fig 346.—Patient before Rhinoplasty Operation

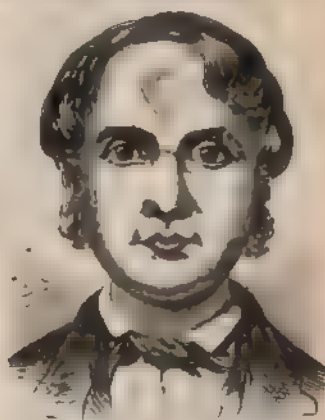


Fig. 347.—Same Patient some months after Operation

patient on whom I operated, before and after the restoration of the lost organ.

The success of the case will depend very greatly upon the minute attention which the surgeon bestows on the details of the operation, and on the care which he takes in the after-treatment. During the operation, the chief points to be attended to are, that the flap be made of sufficient size, that all oozing have ceased before the cut edges are brought into contact, and that no tension nor constriction be exercised. A principal source of failure in

the operation, or in the result so far as concerns the after-appearance of the patient, is gangrene of the flap, in whole or in part, arising from the root being too narrow or too tightly twisted, or from the flap being too roughly handled in its dissection. So also, if it be cut too small and not properly supported afterwards, the result will not be very satisfactory. Other accidents occasionally happen; thus erysipelas may occur, destroying at once the vitality of the flap, or coming on at a later period, and causing the new nose to slough under the attack of inflammation, which it has not sufficient vitality to resist, as happened in one of Liston's earlier cases; or the new nose may be destroyed by a return of the lupus which proved destructive to the old one. Hemorrhage may also occur from underneath the flap. In the last case operated on by Liston before his death, and which was completed by Mr. Morton at University College Hospital, hemorrhage to the extent of more than a pint took place on the ninth day, without any evident cause, from under the flap, and could only be arrested by plugging. Further, the operation is not without its dangers. Dieffenbach lost two patients out of six on whom he operated in Paris; their constitutions probably having been in an unfavourable state.

FISTULOUS OPENINGS THROUGH THE NASAL BONES leading into the interior of the nostrils are occasionally met with. Such apertures as these are, perhaps, best closed by paring the edges, and then bringing forward a flap of neighbouring skin by the gliding operation. In some cases of this kind, procedures may be required, in which the surgeon may display much ingenuity and benefit his patient greatly. The cuts represent a case many years since



Fig. 348.—Opening into Anterior Nares.



Fig. 349.—The same, closed by Operation.

under my care, before and the day after operation, in which a large aperture into the side of the nose, resulting from necrosis of the left nasal bone consequent on scarlatina (Fig. 348), was successfully closed by a flap of skin taken from the forehead by the twisting process (Fig. 349). The patient who was a child at the time of the operation, has now grown into a comely young woman, presenting scarcely a trace of the operation.

OPERATION FOR DEPRESSED NOSE.—Sometimes the nose is depressed and flattened in consequence of the loss of the cartilages, vomer, and septum, though the external parts remain entire. Dieffenbach has proposed a plan for raising it by slitting it longitudinally into three pieces; dissecting the

lateral slips from the osseous attachments; paring the edges to such an extent that they overlap, and stitching them together; then bringing the whole organ forwards by pushing long hare-lip pins across its base, so as to elevate and narrow its attachments, which are brought more into the mesial line. Fergusson has improved this procedure by not slitting the nose down, but dissecting it away from the bones from within the nostril, and then pushing long steel-pointed silver needles across from cheek to cheek, and twisting their ends over perforated pieces of sole-leather, through which they had previously been passed, thus bringing the whole organ bodily forwards. The columna is next fashioned in the way which has already been described; and the nose is completed.

PLASTIC SURGERY OF THE LIP.

HARE-LIP.—By hare-lip is meant a congenital perpendicular fissure or fissures through the upper lip, the result of an arrest of development. The condition thus produced in man is, according to Geoffroy St. Hilaire, not analogous to what is met with in the hare, but to that which occurs in animals of a lower grade of organisation—in fishes. The arrest of development takes place opposite the line of junction between the intermaxillary and superior maxillary bones, and is usually associated with a certain amount of disunion or malformation at the line of junction between these bones. When the arrest of development takes place on one side only, the hare-lip is said to be *Single*. In it the mesial side of the gap is usually rounded; the outer edge is flattened; and the frænum at the angle is long and subcutaneous. It most frequently, so far as I have observed, occurs upon the left side. Not unfrequently there is a fissure on each side of the mesial line; and then the hare-lip is said to be *Double*. When double, the fissure is deeper on one side than on the other, and usually extends into the nostril, and is associated with cleft palate; though sometimes it stops short of this. In these cases the nose is usually flattened and expanded, and between the fissures there is always a central or medium lobule, consisting of the intermaxillary bones in a rudimentary condition; to this a triangular labial nodule is commonly attached. In many cases this is pushed forwards, and tilted on its base, so that the alveolar border projects forwards. Sometimes the projection is so considerable that it is attached to the tip of the nose.

Moham fissure is so rare that there are scarcely any authentic cases of it in the records of surgery. Delahaye, however, mentions one instance of mesial fissure of the upper lip with two lateral fissures, and Nicati has described one in the lower lip, the only case of the kind that I have met with on record.

The cleft in hare-lip corresponds to the line of junction between the embryonic intermaxillary bones and the superior maxilla. The fissure, when single, may be confined to the lip; but in the majority of cases it extends to the alveolus of the upper jaw, giving rise to a deep notch between the outer incisor and the canine tooth. When double, the four incisors, usually imperfectly and irregularly developed, are included in the central intermaxillary tubercle. Meckel and Nicati have described a rare form of hare-lip, in which the fissure corresponds to the line of junction between the central and lateral incisors. In many cases the fissure extends back into the palate; this more frequently happens when



Fig. 350.—Jaw in Double Hare-lip.

the hare-lip is double, and in these cases every variety of palatal deformity is met with (Fig. 350).

Age for Operation.—The cure of hare-lip can only be effected by a properly conducted operation. In the performance of this, the first point that has to be determined is the age at which it should be done. On this there has been, and is still, a good deal of difference of opinion. Surgeons generally are, however, I think, agreed that it is better not to perform the operation during dentition; at all events not during the cutting of the incisor teeth, when there is much local excitement and general irritability of the nervous system; but they are not agreed as to whether it should be done before or after dentition. In support of the opinion that it is more prudent to wait until after this period, it is alleged that very young infants are especially liable to convulsions; that the performance of operations on them is troublesome; and that it interferes with suckling. These statements, however, are not carried out by what we meet with in practice. I think there is no evidence to show that there is any danger in operating during early infancy; indeed, I believe that very young children, those but a few weeks or months old, bear operations remarkably well. I have repeatedly operated at these tender ages, not only for hare-lip, but for hernia, the removal of tumours and navi, the division of tendons, &c., and have never seen any bad results follow. Besides this, the performance of the operation is easier at a very early age than when the child has reached its first or second year; when, intelligence being more developed, it knows what it has to suffer, and screams and struggles more than a very young infant does, whenever it sees the surgeon, or when he makes an attempt to examine the wound or dressing. After the operation also, the child will, when young, take to the breast without difficulty and with the greatest avidity. The act of suction is advantageous, as in it the sides of the incision are more closely compressed and brought together. At very early ages, union of the wound takes place with great readiness and solidity; and, as no time has been given for the rest of the features to become distorted, there will not be that permanent flattening and deformity of the face which is apt to continue after the hare-lip is cured, if the operation be deferred to a more advanced age. For these various reasons I agree with Dubois, Fergusson, and Butcher, that the operation had best be performed early; if possible, at about the sixth week after birth, or from that to the third month, which may, I think, be considered the time of election for this procedure. At this time the vitality of the child is good, and the tissues are not so lacerable as at an earlier age. Should circumstances require it, however, the operation might be done at a much earlier period than this. Thus, at the urgent solicitations of the parents, I have performed it within the first 24 hours after birth, and several times during the first week. But in these early days of life the operation is not without danger; the vitality of the child is often feeble, it suffers greatly from the loss of even a very small quantity of blood, and the tissues are so lacerable that there is great danger of the pins or stitches cutting out. I would therefore not advise its performance then.

It is scarcely necessary to observe that, as union by the first intention is aimed at, the operation should not be undertaken unless the health be good, and certainly not if the child, at whatever age, have but recently recovered from measles, scarlet fever, or other infantile disease.

OPERATION FOR HARE-LIP.—In the treatment of hare-lip, there are three main objects to be kept in view: 1. The procuring of union by the direct adhesion of the out edges of the fissure; 2. The prevention, as far as possible, of deformity during the process of union, and, 3. The avoidance

of all traction on the line of incision that may interfere with these results.

These principles of treatment are carried out by paring the edges of the fissure freely, bringing them together by means of the twisted or interrupted suture, and taking off all tension by means of strips of plaster and the cheek-compressor. But the details of the treatment vary so much, according as the fissure is single or double, or complicated by more or less projection of the intermaxillary portions, that the steps of each operation require to be separately described.

Single Hare-lip.—The operation for single hare-lip is performed in the following way. The child having been well pinned in a jack-towel that swathes it tightly, the surgeon, sitting down, places his feet on a stool so as to raise them; and, covering his knees with a piece of tarpanlin, holds the child's head firmly between them. He first freely divides the frænum and all membranous connections between the angle of the cleft and the gum of the upper jaw, and then, putting the lip on the stretch by seizing the extreme edge of the cleft with a pair of artery-forceps or a tenaculum, pares the edges of the cleft by transfixion with a narrow-bladed bistoury, or fine scalpel, from above downwards, first on one side, then on the other; taking care that the incisions unite neatly and cleanly above the upper angle of the fissure, which must be well cut out; and that they extend sufficiently far outwards to cut away the rounded portion of the prolabium which forms the side of the base of the fissure. Care should be taken that enough is cut away; there is more danger usually of taking too little than too much.

In single hare-lip, where the lips are very lax, the incisions may be straight; but if the gap be wide and the tissue deficient, or in double hare-lip, they should be somewhat concave inwards; in this way there is less likelihood of an unseemly notch being left (Fig. 353).

Fine hare-lip pins, made of soft iron wire, with steel points, should then be deeply introduced through the lip from one side of the fissure to the other. The pins should be entered at about a quarter of an inch from the pared edge on one side, and brought out at a corresponding point on the other; care being taken that, though they are passed deeply, the mucous membrane is not transfixed—if it be, it will be doubled into the wound, and thus interfere with union. Two pins are usually required: if the child be some years old, and the fissure very long, three may be used. The lower pin should be introduced first underneath or through the cut labial artery, in such a way that its pressure may stop the bleeding from this vessel, which is often rather free: in passing this pin, great care should be taken to bring the opposite sides of the fissure well into contact, so as to be on a level below, that no irregularity may be left in the prolabium. The twisted suture is then applied



Fig. 351 —Application of Twisted Suture.



Fig. 352 —Application of Pins and Sutures in Hare-Lip.

in the usual way, (Fig. 351) first round the lower pin, and then round the upper one (separate threads, however, being used for each); and lastly, the two are united by a few cross turns, so as to press down and support the whole length of the fissure (Fig. 352). In applying the twisted suture, the surgeon

must be careful, whilst drawing the edges closely into apposition, not to apply the threads too tightly, lest sloughing result; and in crossing the from one pin to the other, great caution must be used not to draw the pins together horizontally, lest puckering of the line of union take place. The pins are then cut short, the whole is coated with a layer of collodion, and a piece of plaster is put under the ends of the pins to prevent excoriation of the skin. In addition to the pins and twisted suture, I invariably introduce one point of interrupted suture through the mucous membrane of the lower part of the fissure, just inside the mouth; and I look upon this of great consequence in order to prevent the notching, which is otherwise very apt to occur, in consequence of that portion of the incision between the lower pin and the edge of the lip being kept open by the child in suckling or protruding its tongue against it. At the end of from 72 to 96 hours, according to the age of the child, the pin should be withdrawn, or it may be removed by pushing it through the lip by a gentle rotatory movement, in a way that the cut end does not tear or lacerate the aperture in the lip. The threads, matted together with exudation and a little blood, form a good crust which may be left on for two or three days longer, and then allowed to separate of itself; the less any crusts that form over the line of incision, and interfere with, the better will usually be the result. The lip may, if thought desirable, be supported by a strip of adhesive plaster, which should, indeed, be continued for about a fortnight after the operation, so as to prevent stretching of the cicatrix and notching of its lower part. The point of interrupted suture may be left in for about four days. It sometimes, though rarely, happens in single hare-lip that the intermaxillary portion is so large and projecting, that there is difficulty in bringing the lateral segments together of it. Should this be the case, the better plan is to notch it at its alveolar border in the side that is not fissured, and then to break it back so as to remove all projection. If the fissure be wide, and the child restless, so that there is danger of the parts being dragged upon during its screaming or crying, it is a very good plan to apply the spring cheek-compressor, invented by Mr. Hainsby, here represented (Fig. 353). Indeed, whenever

obtainable, this excellent contrivance should be employed. Its use adds greatly to the success of the operation.

Double Hare-lip.—The operation of double hare-lip is performed on the same principle as that for the single form of the disease, viz., of procuring union by adhesion between the opposite surfaces. The difference in the operations consists chiefly in dealing with the intermediate portion of the lip and alveolus. The management of the intermaxillary process must vary according to its size and degree of projection. If it be small and rudimentary, or fixed to the tip of the nose, as in Fig. 355, it should be cut off with bone-nippers, as it would prevent the lateral segments from coming into proper apposition. More commonly, when this is done, there is



Fig. 353.—Hare-lip. Spring Cheek-compressor

and even dangerous bleeding from a dental artery deep in the bone, which requires to be touched with a red-hot needle or wire before the hemorrhage from it will cease. If the central intermaxillary portion be large and projecting

ould be bent or broken back by strong forceps covered with vulcanised rubber. If it be large and not projecting, the soft parts should be pared on each side, and transfixed by the hare-lip pins, and thus be joined between and united to the pared lateral surfaces; indeed, it is always advisable not to remove this, unless it be awkwardly situated, as in 354. When it is left, though the union may not appear quite so perfect



Fig. 354.—Hare-lip. Projecting intermaxillary portion.



Fig. 355.—Hare-lip. Intermaxillary portion fixed to nose.

and uniform as it would if the lateral halves had been directly united, yet eventually the case will turn out better; the central portion becoming developed, and forming the natural mesial projection of the lip, which is lost when the lateral halves are directly united. Butcher has invented some very simple and ingenious forceps for the partial section and bending back of the intermaxillary process. In some of these cases great nicety is required in planning the incisions, and in the introduction of the sutures. The central portion is most advantageously pared in a somewhat concave manner, so that the freshly cut edges of the lateral halves are received into and more accurately fitted upon it. Should, as often happens in single as well as in double hare-lip, one of the lateral segments be tied down to the gum and alveolus by a doubling of mucous membrane, this must be freely divided, and the portion of lip, with perhaps the corresponding ala of the nose, freely dissected up from the osseous structures, so as to admit of its being moved forwards without too much traction being put upon it.

Treatment by Simple Suture.—During several years I have been in the habit of treating hare-lip of all kinds, double as well as single, with the simple interrupted suture alone, without using any pins. I have in this way treated most successfully many cases in children, whose ages have varied from a few days to four years, with most satisfactory results, and with less marking of the lip than I have ever seen attend union by means of the twisted suture, to which I now generally prefer the simple suture as being equally safe, more simple, and followed by less scarring of the lip, provided the case be not too complicated, nor associated with very wide fissure in the palate, or with great projection of the intermaxillary bones. In these circumstances, the pins should be preferred.

When the fissure is single, the edges, having been pared in the usual way, should be brought together by two points of suture; the first passed deeply near the free edge, and in such a way as to compress the cut coronary artery; the other nearer the nasal angle. These sutures should be of thick well-waxed dentist's twist that will not cut out too readily, or, what is better, of silver wire. A point of fine interrupted suture should then be inserted through the mucous membrane inside the lip. The lip may then be supported by two narrow strips of plaster, one placed between the sutures, the

other between the upper suture and the nose. On the third day the upper suture should be taken out, but the lower one may be left in for a day or two longer, when it and the one through the mucous membrane may be removed together, unless the latter has already cut its way out. If silver wire sutures are used, they may be left in for six or seven days without producing irritation. The lip must then be supported for a few days with a strip of plaster.

In the case of double hare-lip the same plan is to be adopted, first on one side, then on the other; but here, as the gaps are wider, and the tension, more particularly when the intermaxillary prominence is very projecting, is apt to be considerable, it is necessary to support the cheeks, and thus to prevent undue traction on the stitches, by means of the cheek-compressor. In this way all risk of the stitches cutting out before union is completed is avoided; and excellent and solid union will speedily be obtained, even in cases of double hare-lip, with some intermaxillary projection and fissured palate.

The operation occasionally fails. The probability of the occurrence of such an untoward event is, however, greatly diminished by the use of the cheek-compressor. It may, however, happen either in consequence of the child's health being in an unsatisfactory state, so as to prevent union by the first intention; or in consequence of the pins having been withdrawn too early, before secure cohesion has been effected. Under such circumstances as these, an attempt might be made to unite the granulating edges by the re-introduction of the pins or sutures, and by firmly fixing the lip by means of the cheek-compressor. Such attempts, however, rarely succeed; should they not do so, it will usually be found most prudent to wait at least a month before taking any further steps, and then to pare the edges afresh and repeat the original operation.

CONGENITAL TRANSVERSE FISSURES OF THE CHEEKS, extending from the angle of the mouth to the anterior border of the masseter or up towards the malar bone, are occasionally met with, and have been specially described by Klein and Nicati. Such malformations require to be treated on exactly the same principles, and with the same attention to details, as hare-lip; union between the pared edges being effected by means of hare-lip pins and the twisted suture.

CHEILOPLASTY.—Simple plastic operations are commonly practised on the lower lip for the removal of cancrroid disease, by cutting out a V-shaped piece of the lip, including the whole diseased structure, and then bringing together the opposite sides of the incision by hare-lip pins. These operations have already been described and figured at page 860. We shall consider here those cases in which it becomes necessary to repair more or less extensive loss of substance in the labial structures. The restoration of a portion of the lip that has been destroyed by accident or disease, is not so readily effected as that of the nose; yet a good deal may be done to restore the deformity. The plan originally introduced by Chopart consists, when it is the lower lip that is deformed, in carrying an incision from behind the lower jaw down to the hyoid bone, so that a square flap may result, which is detached from above downwards. This flap is then brought up, and fixed to the pared edges of the remaining portion of the lip by points of suture; the head being kept properly inclined, in order to prevent undue tension. After sufficient union has taken place to preserve the vitality of the flap, its lower attachment may be divided. The flap should, if possible, not be twisted, though it is not always practicable to avoid this. This operation is not usually very satisfactory in its results, as the new flap is apt to become

oedematous and inverted at the edge, or the flow of saliva may interfere with proper union. In those cases in which the greater portion of the lower lip has been excised for cancerous disease affecting its upper margin, the most successful procedure for the restoration of the deformity consists in a modification of the plan recommended by Serres; and from this I have derived excellent results, as in the case which is here represented (Fig. 356). The



object of the operation is to raise the lower lip to a level with the incisor teeth. An incision, about three quarters of an inch in length, is made directly outwards from the angle of the mouth, on each side, into the cheek; from the extremity of this, a cut is carried obliquely downwards on to the upper margin of the lower lip, so as to excise the included triangular piece;



Fig. 356 — Lines of Incision in Cheiloplasty Fig. 357 — Incisions and Sutures in Cheiloplasty

the lower lip is then dissected away from the jaw, from the inside of the mouth, and a V-shaped piece is taken out of its centre. By means of a hare lip pin on each side, and a point of suture, the incisions in the angle of the mouth are brought accurately together; and in the same way the vertical one, in the centre, is united (Fig. 357). In this way the whole of the lower lip is raised, and brought more forwards. If care have been taken, in removing the cancer from the edge of the lip, to leave the mucous membrane rather long (which may always be done, as the skin is affected to a greater extent than it), a good prolabrum may be formed, and the restoration effected with but little deformity. Care must be taken to prevent union from occurring between the inside of the lower lip and the gum, by the interposition of a strip of oiled lint.

Dr. Buchanan, of Glasgow, as far back as 1841 published an account of a method for restoring the lower lip when affected by extensive cancerous

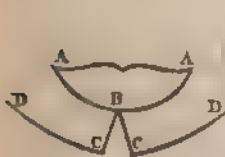


Fig. 358



Fig. 359



Fig. 360.

Buchanan's Operation for the Restoration of the Lower Lip.

disease, which leaves most satisfactory results. The accompanying figures illustrate the kind of case in which Dr. Buchanan's operation is applicable,

the lines of incision required, and the appearance presented by the chin and lip after the disease has been removed, and the flaps brought into proper apposition.

The steps of the operation are simple, and the result is excellent.

The diseased part of the lower lip is first removed by an elliptical incision (Fig. 358, *A B A*). An incision, *B C*, is then carried downwards and outwards on each side on to the chin; and another incision, *C D*, upwards and outwards parallel to, and corresponding in length to, *A B*. The flaps formed by these incisions are represented in Fig. 359. They are detached from their subjacent connections; and the whole is raised upwards, so that the original elliptical incision comes into a horizontal line, and is made to constitute the margin of the new lip; the secondary incisions under the jaw coming together in a vertical direction, in which they are retained by twisted and interrupted sutures (Fig. 360).

PLASTIC SURGERY OF THE PALATE.

Various degrees of congenital deformity may occur in the palate and uvula; thus the uvula alone may be bifid, or the cleft may extend through the greater part of the whole of the soft palate; or the hard palate may be divided as well (Fig. 361); and, lastly, the separation may extend forwards to the integuments of the face, producing single or double hare-lip. The soft palate and uvula are not unfrequently cleft without the hard palate being divided; and, in some very rare cases, the lip and the hard palate are fissured without the soft one being cleft.



Fig 361. Fissure of Hard and Soft Palate

These malformations necessarily give rise to great inconvenience, by interfering with deglutition, and rendering speech nasal and imperfect. During the swallowing of fluids, there is a tendency to regurgitation

through the nose, though this is occasionally prevented by the approximation of the edges of the fissure in the soft palate.

Age for Operation.—In the treatment of these malformations, the first question to be determined is the age at which the operation should be performed. As the success of the operation depends in a great measure upon the patient remaining perfectly tranquil and steady during the necessary procedures, which are of a tedious and protracted character; upon his assisting the surgeon by opening his mouth, and not struggling on the introduction of the instruments; and, after the operation, upon his making as little movement as possible in speech or deglutition for some days; it is usually considered expedient not to interfere with this malformation until the patient has attained the age to understand the necessity of remaining quiet, and to be able to control his movements; yet some observations by Ferguson and Sedillot have shown that the necessary operation may be done successfully on young children. It need scarcely be remarked, that the general health ought to be in the best possible state, before any procedure requiring immediate union of parts be attempted.

STAPHYLOPLASTY.—The operation for the cure of a cleft in the soft palate may be said to have been introduced by Roux; for, although several attempts at the cure of this deformity had been made by surgeons before his time, yet he was the first to establish Staphyloplasty as a distinct operation. Many

modifications of Roux's plan have been practised by Grafe, Warren, Dieffenbach, Liston, and others, in order to render it more easy of execution and certain in its results, and especially by making incisions through it so as to take off the traction on the sutures, but to Fergusson is due the great merit of introducing a new principle of treatment in the operation—viz., the application of myotomy to it, thus paralysing the movements of the muscles of the palate. Fergusson found that the great cause of failure in these cases was the mobility of the parts, and the traction exercised by the muscles, principally the levator palati and the palato-pharyngeus, on the line of union; in order to obviate this, he conceived the happy idea of dividing these muscles. Before Fergusson laid down the principles of this operation it is true that various cuts had been made in the palate by different surgeons, with the view of taking off the tension after the sutures were tied. Thus Dieffenbach, Pancoast, and Liston, all recommend that the traction on the stitches should be lessened by longitudinal or transverse incisions across the *velum pendulum palati*. Mettauer practised several small incisions for this purpose; and Mason Warren divided the anterior pillar of the fauces and its attachments to the posterior pillar, coming nearer than any previous operator to Fergusson's method. These operations, however, were done almost at haphazard, and in an empirical way, without the recognition of any distinct principle being involved in them.

In the operation as performed by Fergusson, there are four distinct stages. 1. *The muscles of the palate are divided*, by passing a curved lancet-ended knife through the fissure behind the velum, midway between its attachment to the bones and the posterior margin, and about half-way between the velum and the end of the Eustachian tube. By cutting deeply with the point of the knife in this situation, the levator palati is divided. The uvula is then seized and drawn forwards, so as to put the posterior pillar of the fauces on the stretch, which is to be snipped across, so as to divide the palato-pharyngeus. The anterior pillar, the palato-glossus, may then be notched in a similar way. 2. *The next step in the operation consists in paring the edges of the fissure from above downwards*, by means of a sharp-pointed bistoury. This is best done by seizing the lower end of the uvula, putting it on the stretch, and cutting first on one side and then on the other, leaving the angle of union to be afterwards removed. The patient should then be allowed to remain quiet, and to gargle the mouth with cold water or to suck ice, so as to stop the bleeding. 3. *When the bleeding is arrested, the surgeon proceeds to the next step, that of introducing the sutures*; this may be done by means of a *nerve-needle*, armed with a moderate sized thread, being passed from below upwards on the left side of the fissure, about a quarter of an inch from the margin; the thread should now be seized with forceps, and one end of it pulled forwards through the fissure. This may again be threaded in the needle and passed through the opposite side of the fissure from behind forwards through the right side; as the point of the needle appears, the thread should again be seized and the needle at the same time withdrawn; the suture is then tied by means of the surgeon's knot; and in this way, according to the extent of the fissure, from two to four sutures may be passed and tied lightly, and the knots cut close. An important improvement in this method of passing the sutures is now very generally adopted. It consists in passing a single suture through the left side of the cleft from before backwards in the usual way. A needle, having an eye at its point, and threaded with a loop instead of a single thread, is now passed through the right side of the cleft, the loop drawn through, and the needle removed. The single suture is then slipped through the loop.

This is then withdrawn, carrying with it through single ligature. In this way the sutures, being before backwards, can be inserted more evenly puckering when knotted. In tying the knots, that no undue traction be exercised upon the sutures is not to draw, but simply to hold, the of the muscles has caused these to be relaxed, so and merely require to be held in apposition must next be put to bed, and every care taken the palate. He should be restricted to fluid days, and should be directed to swallow this and indeed should not be allowed anything solid taken place. All coughing, spitting, or swallowing interdicted. 4. *The stitches should be left in* need not be disturbed so long as they produce require removal by the eighth or tenth day, with advantage for some time longer, until the union is perfect; they should then be cut out, the upper one first, the middle next, and there be any aperture left in the palate, where this may be closed by touching it with a point.

The voice in these cases does not usually at after the operation, although in some cases it month or six weeks, the patient may advantage of instruction, with the view of regulating the the actions of the soft palate.

In dividing the levator palati, Pollock adopts that of Fergusson. Instead of cutting from through the curtain of the soft palate so as to then pushing a narrow-bladed knife through side of the hamular process, he readily dividing raising the handle and depressing the point. levator palati, which is analogous to the plan Sédillot (Figs. 362—364), appears to be more

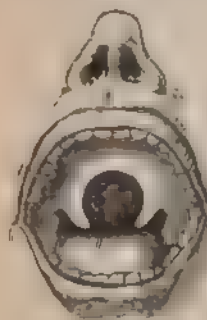


Fig. 362.

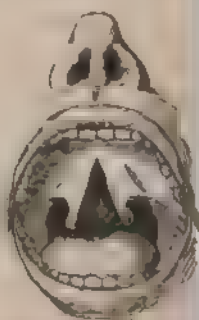


Fig. 363.

Sédillot's Operation for Stenopharynx

than the division of the muscles of the velum from left closes without difficulty by granulation, and tension from the parts.

CRANOPLASTY.—*Fissures of the Hard Palate* are usually closed by means of "obturators" made of gold, vulcanised India-rubber, or ivory. To Dr. Warren, of Boston, is undoubtedly due the merit of having been the first to close these fissures by a surgical operation. This he did by dissecting the soft tissues from the palatal arch between the margin of the cleft and the edge of the gum, and then uniting them in the middle line by means of stitches in the same way as in fissured soft palate. This operation has been brought before the Profession in this country by Avery and Pollock, who have invented some ingenious instruments for its proper performance.

The operation is performed in the following way. An incision having been made along the edge of the cleft, at the junction of the nasal and palatal mucous membranes, the soft covering of the hard palate is carefully dissected or scraped down off the bones by means of curved knives, great care being taken that the mucous membrane and its subjacent fibro-cellular tissue, which varies greatly in thickness in different cases, be not perforated. Langenbeek has particularly recommended that the periosteum be detached with the fibro-mucous tissue. When these structures have been well loosened on each side, the covering of the palate will be found to hang down as a curtain from the vault of the mouth,—the two parts coming into apposition along the mesial line, or possibly overlapping.

The edges, being then smoothly pared, are brought into apposition by means of a few points of suture, introduced in the ordinary way and without any dragging. On this point great care is necessary. The knots having been tied, the patient is confined to bed for several days, and allowed an abundant, but fluid or pulpy diet. Union will usually be found to be perfect at the end of a week. At a later period, the fissure in the soft palate, which always accompanies that in the hard, should be closed: but it is of the greatest consequence that this should not be attempted at the same time that the operation is done on the hard palate.

PERFORATION OF THE HARD PALATE.—Perforations of the hard palate, consequent on necrosis of the bones, the result of syphilis or injury, are not amenable to surgical treatment. In such cases, a well fitting obturator will most effectually remedy the inconvenience.

CHAPTER LIX.

OPERATIONS ON THE AIR-PASSAGES AND CHEST.

LARYNGOTOMY AND TRACHEOTOMY.

The windpipe may either require to be opened to allow of the formation of a temporary breathing aperture, in consequence of the obstruction of the larynx by causes that are speedily removable; or it may be necessary to establish a permanent opening in the air-passages in those forms of chronic laryngeal disease, in which the obstruction depends upon organic alterations of structure which are not remediable.

Among the conditions requiring *temporary aperture*, may be mentioned all acute inflammatory affections of the larynx that give rise to obstructive oedema of the glottis; also traumatic conditions, such as the impaction of masses of food in the gullet, inducing asphyxia, and not capable of being immediately removed; scalds of the rima glottidis; the presence of foreign bodies in the

air-passages; and œdema of the glottis from wounds of the thyro-hyoid membrane.

The establishment of a *permanent aperture* in the air passages is especially required in chronic diseases of the larynx, attended by thickening of the mucous membrane, by abscess, or by necrosis of the cartilages—in fact, by any such conditions as do not admit of removal; so also, in polypi of the larynx, a permanent opening below the obstructed point may be required.

Opening the Windpipe in Croup and Diphtheria.—The question as to whether the windpipe should be opened in cases of croup has been much discussed. Were croup merely a disease of the larynx, and did death in it result from simple laryngeal obstruction, it would doubtless be proper to perform this operation. But in croup there are two distinct sources of danger; 1, that arising from asphyxia dependent on laryngeal inflammation, obstruction by plastic deposits, and spasm; and 2, that which is due to the extension of inflammatory action below the larynx into the bronchi and lungs. By tracheotomy we can doubtless remove so much of the danger as arises from the laryngeal obstruction, but we cannot remove that which is dependent on the often concomitant broncho-pneumonia. In this respect the propriety of performing tracheotomy in the croup of children differs remarkably from the expediency of having recourse to the same operation in the acute laryngitis of adults, in which the lungs are rarely implicated to a serious extent. In fact, the question as to the performance of tracheotomy in the croup of children must be answered by the amount of laryngeal asphyxia and the extent of pulmonary implication. If the child be in danger of death from uncomplicated laryngeal inflammation, obstruction, and spasm, timely tracheotomy will undoubtedly rescue it from this immediate danger, and will be a proper operation; but, if extensive broncho pulmonary inflammation already exist, it will be worse than useless, and should on no account be practised. A serious objection to the performance of tracheotomy in the croup of young children is, that it is by no means an easy operation or one devoid of immediate danger. If chloroform be not given, the struggles and writhings of the child will materially embarrass the surgeon in his attempts at opening the windpipe. But even if chloroform be administered, which should always be done when practicable, and this source of difficulty removed, there is, unless care be taken, no little danger of hemorrhage; and I have heard of several cases in which this has occurred to a fatal extent. Although, therefore, as a general rule, I fully agree with Porter in reprobating this in ordinary cases of croup, yet cases are doubtless occasionally met with, in which the disease is so clearly limited to the larynx—the respiration being free throughout the lungs and bronchi—that the surgeon may feel himself justified in endeavouring to save the little patient, struggling against overpowering asphyxia, by opening the windpipe. In several such cases, to which I have been called by other practitioners, and which were apparently most favourable to the operation, I have considered myself justified in doing this, though rarely with ultimate success. I believe that the general experience of British surgeons is unfavourable to it. On the other hand the French surgeons, and more particularly Trousseau, are strenuous advocates for the performance of tracheotomy in croup, and the operation is accordingly far more extensively practised in France than in this country. But even in Paris it is not a very successful procedure; thus it appears that, at the Hospital for Sick Children in that city, the operation was performed in 215 cases in five years, and that of these only 47 were cured. Unless we assume

that the disease, as occurring in Paris, is different from the form of croup we meet with here, it may fairly be doubted whether an operation which is in itself dangerous could be necessary in many of these instances, and whether a large proportion of the children might not have recovered under ordinary medical treatment and without having recourse to operation.

In *Diphtheria*, as in croup, there are several sources of danger. There is not only peril from the obstruction of the pharynx and larynx, by inflammation and the accumulation of exudation-matter, to such an extent as to induce asphyxia, but there is also liability to pulmonary inflammation and congestion, blood poisoning, and exhaustion of the system. In diphtheria, as in croup, tracheotomy may be performed when the patient is in imminent danger of death from laryngeal obstruction; and by it the fatal event may be warded off so far as it arises from this cause, and time be thus afforded for proper treatment. Even though the relief afforded by tracheotomy be only temporary in the majority of cases, and the patients generally eventually die of the constitutional symptoms, yet it is obviously proper in cases still uncomplicated, and where the danger of death from laryngeal asphyxia is imminent, that the surgeon should rescue the patient from his instant peril, and give him his only chance of prolonging or of preserving life, by opening the windpipe,—the trachea in children, the larynx in adults, being most suitable for operation. It has been very justly observed by Dr. Jenner that, by opening the windpipe in these cases, we save the patient from so terrible a death as that by asphyxia; and even if life be ultimately extinguished by the disease, temporary ease will have been afforded the patient, and death will occur in a less distressing manner; and that, if only one life in a hundred could in this way be saved, we should be justified in having recourse to the operation.

The prospect of saving life after opening the windpipe in cases of diphtheritic asphyxia will greatly depend upon the age of the patient. Under two or even three years of age, recovery is extremely rare; as age advances, the chance of life proportionately increases, and in adults the prospect of recovery is considerable. In many cases the patient will get great temporary benefit from the operation, and will appear to be doing well for several days, perhaps for eight, ten, or fourteen; and then to the great disappointment of the surgeon he will die, not from the effects of the operation, but from blood-poisoning or from the extension of the disease to the bronchi and lungs.

After operations of tracheotomy in croup and diphtheria, it is a question how long the tube should be left in. As a general rule, I think from three to four days are sufficient, care being taken to cleanse it thoroughly during this period. After withdrawal, respiration will in a great measure be carried on through the aperture, which will but gradually close. Should this prove insufficient, the tube may always be inserted again. Occasionally false membranes are expelled, or may be withdrawn from the opening in the windpipe; and through it the interior of the larynx may be spunged out with solution of nitrate of silver, if thought desirable.

NECESSITY FOR PROMPTITUDE.—When it has been determined to open the windpipe for acute disease, more especially supervening on chronic laryngitis, the less delay there is in having recourse to operation, the better; as the patient may at any moment be seized with laryngeal spasm, and be carried off. The operation ought always, however, to be completed, even though the patient have apparently expired before the windpipe has been opened; for resuscitation may, even in these extreme cases, be effected by artificial respiration. When life hangs on so slender a thread as it does in urgent cases of laryngeal obstruction, the first touch of the knife may cause a

spasmodic seizure that may give rise to apparent death. It has twice happened to me to operate under such circumstances, and in both cases to be fortunate enough to save the patient's life. In one case to which I was called some years ago by my friend Mr. E. Baker, the patient, an elderly woman, was apparently dying from the supervention of acute upon chronic laryngeal disease. I lost no time in making an incision into the crico-thyroid membrane, but at the first touch of the knife she sank back apparently dead. I immediately completed the operation, and introduced a large silver tube, through which the lungs were inflated; in the course of a few minutes, the action of the heart recommenced, and the patient eventually recovered. She has never, however, been able to breathe without the silver tube, which she wears in her windpipe up to the present time. In another case to which I was hastily summoned by my friend Mr. Tweed, I found the patient, a young woman, in the last stage of asphyxia from acute disease of the larynx. I immediately proceeded to operate, with the assistance of my then house-surgeon, now the Professor of Surgery at Glasgow, Mr. Lister. As the patient's neck was short and thick, and the veins excessively turgid, there was profuse hemorrhage on the first incisions being made; while we were waiting a minute or two until this would cease before opening the windpipe, the patient fell back and apparently expired. I lost no time in plunging the scalpel into the crico-thyroid membrane, and cutting down through the cricoid cartilage, so as to make a free aperture into the air-passages. On endeavouring to set up artificial respiration, I found the chest clogged with inspissated mucus, which prevented the entrance of air into the lungs; the life of a fellow-creature being at stake, and dependent on the immediate and full establishment of artificial respiration, I felt that there was only one thing to be done—to empty the chest of the matters loading it, and that this must be done instantaneously. I accordingly applied my lips to the wound, and sucked out three or more mouthfuls of blood and mucus, when I had the satisfaction to see that air could be made to enter the lungs. By keeping up artificial respiration for some time, the heart began feebly to act, the face to become less livid, and the circulation to be re-established, the patient eventually did well, and is now alive and in good health.

OPERATIONS.—In opening the windpipe, the surgeon has the choice of two situations in which he may make the aperture; either in the crico-thyroid membrane by *Laryngotomy*, or in some part of the trachea by *Tracheotomy*. Besides these two established operations, some surgeons have performed a third—*Laryngo-tracheotomy*, by opening the crico-thyroid membrane, and dividing the cricoid cartilage with the upper rings of the trachea.

Whichever operation is performed, so soon as the windpipe is opened, the patient is seized with an attack of spasm and convulsive cough, often attended by much struggling and distress, during which the whistling occasioned by the passage of the air through the new passage is very loud and marked. The patient, however, soon recovers himself, and then breathes naturally and easily, the signs of asphyxia disappearing.

LARYNGOTOMY is an easy operation. The crico-thyroid membrane is almost superficial, and may readily be reached by making a vertical incision in the mesial line, between the sterno-thyroid muscles, about an inch in length, and then a cross cut through the membrane with an ordinary scalpel. The air-passages having thus been opened, a silver tube, curved on the flat, may be readily introduced and retained by tapes round the neck. The only troublesome result that can occur in this operation is the wound of a small arterial branch, the inferior laryngeal, which crosses the membrane.

I have never seen any trouble arise from this ; but, should it occur, the hemorrhage would readily be arrested by the application of pressure or suture.

TRACHEOTOMY consists in making an opening into some part of the trachea, exposing the tube and cutting across one or more of its rings.

In performing tracheotomy, the patient's shoulders should be supported with pillows, and his head be thrown as much back as practicable. An incision about an inch and a half in length should then be made with a scalpel, directly in the mesial line, from the cricoid cartilage downwards, after dividing the integuments, any veins that present themselves should be avoided as carefully as possible, being held aside with a blunt hook. By using the point of the scalpel to a limited extent, and dilating the deeper portions of the incision with its handle or with a director, the trachea may be reached with safety.



Fig. 365.—Operation of Tracheotomy.

It should then be transfixed and drawn forwards by a sharp hook, and opened by pushing the point of the knife, with its back turned towards the sternum, between two of the rings, and cutting upwards, through about three of them (Fig. 365). The tube must then be introduced, and retained by tapes round the neck.

The question as to the safety of the administration of chloroform in these operations often occurs. I believe that it may always be given safely except in cases of extreme syncopal asphyxia, where, as sensibility no longer exists, it is unnecessary. Laryngeal inflammation and obstruction is always associated with so much spasm, more particularly in children, that it will often be found that the patient respire more easily and fully whilst under the influence of chloroform than before it commenced its inhalation ; and, as the anaesthesia materially facilitates the operation by doing away with his writhings and strugglings, I now invariably have recourse to it where I perform tracheotomy on children. In laryngotomy in the adult, it does not appear to me to be necessary.

Difficulties.—This operation is often attended by extreme difficulty, and not unfrequently by much danger.

The difficulties occurring in tracheotomy are chiefly referrible to four heads, 1, Difficulty in Exposing the Air-tube ; 2, Profuse Hemorrhage ; 3, Difficulty in Opening the Air-passages ; and 4, Trouble in Introducing the Trachea-tube.

1. The difficulty in *Exposing the Tube* increases greatly as the incisions approach the sternum, and is especially great in children and in stout short-necked persons.

There are three situations in which the trachea may be opened ; either above, underneath, or below the isthmus of the thyroid body, which usually crosses the air-tube opposite its third or fourth ring. Above the isthmus, the trachea is comparatively superficial, and is not covered by any venous plexus, nor does any other source of difficulty present itself to the surgeon.

Where the isthmus crosses the trachea, this tube is overlaid by a venous plexus as well as by the glandular structure. Below the thyroid gland, the air-tube is overlapped by the sterno-hyoid and sterno-thyroid muscles, and by the inferior thyroid veins, which are of large size, together with some tracheal branches from the inferior thyroid artery; and not unfrequently an irregular arterial branch ascends in this situation in front of the trachea to supply the thyroid body. The carotid arteries also are in close relation to the trachea on each side; and opposite the episternal notch it is crossed by the left carotid and by the innominata, which vessel has been seen by Macilwain to cross the tube at the very point where tracheotomy is usually performed. A glance at these important relations will suffice to indicate the difficulty that must, in many cases, occur in exposing and opening the trachea. This difficulty is greatly increased when the veins of the neck have become turgid in consequence of the pulmonic obstruction. It will also be seen that the trachea is less covered, and may consequently be much more readily reached above, than below the isthmus of the thyroid gland. Though some surgeons, as Velpeau for instance, have recommended the opening to be made in the lower part of the tube, no advantage whatever is gained by so doing, whilst the difficulties of the operation are only seriously increased; and in practice it is almost invariably opened at its upper part, usually between the second and third or third and fourth rings, though the incision may, if necessary, be carried downwards as low as, or even through the isthmus.

2. The *Hæmorrhage* may occur either from arteries, from veins, or from the thyroid gland. Arterial hæmorrhage is less frequent and troublesome than the bleeding from other sources. When it occurs, it chiefly happens from the wound of some anomalous branch, or from that of the small tracheal vessels. Desault has, however, mentioned a fatal case, in which death arose from a wound of the carotid. The arterial anastomosis of the isthmus of the thyroid body may, if this part be enlarged, occasion some difficulty in the performance of the operation; but the main source of danger unquestionably proceeds from the *venous bleeding*. Not only are the plexuses of veins of large size, more particularly where they cover the lower part of the trachea, but they become immensely gorged by the asphyxia that necessitates the operation. Hence, when they are wounded, the bleeding may be so abundant as scarcely to be controllable, and may very greatly retard the after-steps of the operation. Many surgeons of authority in these matters advise that the windpipe should not be opened until all, or nearly all, the bleeding has ceased; lest the blood, entering the bronchi and lungs through the aperture, asphyxiate the patient. But in this way much valuable time may be consumed, and the patient may be fatally exhausted by a tedious and prolonged operation, and by the loss of an unnecessarily large quantity of blood. The hæmorrhage in this operation is almost entirely venous, and is, in a great measure, dependent on the distension of the veins of the neck, which occurs in asphyxia as the result of the accumulation of blood in the right cavities of the heart, consequent upon the obstructed circulation through the lungs; and the bleeding will continue so long as that obstruction remains unremoved. But as the respiratory process is re-established, this obstruction to the pulmonic circulation diminishes, the cardiac cavities become unloaded, the venous turgescence of the neck subsides, and the hæmorrhage proportionately lessens. This I have repeatedly found in asphyxia artificially induced in animals; and I have often seen it in the human subject, in cases in which it has become necessary to open the windpipe at once, without waiting to arrest hæmorrhage. Hence, except in

those instances in which an arterial twig or large venous trunk has been wounded, and which must of course be secured, the occurrence of bleeding, though tolerably smart, need not deter the surgeon from opening the windpipe; as the relief afforded to respiration will induce a corresponding and rapid diminution in the venous turgescence of the neck, and in the consequent flow of blood from the wound.

3. Another difficulty in tracheotomy sometimes attends the process of *Opening the Trachea* after it is exposed. In consequence of the convulsive breathing of the patient, the sterno-mastoids are put upon the stretch, thus increasing considerably the depth of the wound in the neck; and, at each short and gasping respiration, the air-tube is rapidly pumped or jerked to and fro, approaching to and receding from the surface in such a way that the scalpel cannot be thrust into it with safety. In order to do this with the least risk, a sharp-pointed hook should be passed between two of the rings, and the tube, being thus fixed, opened by cutting upwards (Fig. 365).



Fig 365.—Trachen-hook—Director.

the hook, being grooved along its convexity, as Dr. Edwards recommends (Fig. 366), is to be introduced under the cricoid cartilage, and the air-tube pulled up and opened by sliding the scalpel along the groove of this hook-director. I have found it advantageous in some cases to open the trachea with a cutting hook, such as is here represented (Fig. 367). By means of

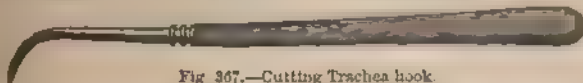


Fig 367.—Cutting Trachea hook.

an instrument of this kind, the trachea is first fixed and then divided without danger to the patient. The danger from hemorrhage, and the difficulty in opening the trachea, are much greater in children than in adults. Before the age of puberty, this tube is deeply seated, covered with a quantity of loose granular fat, containing many veins, and is of small size, so that a slight deviation of the incision to one side or the other may readily lead the surgeon astray, and into dangerous proximity with the carotid artery.

4. After the trachea has been opened, the next point is to *Introduce a proper Tube*. In doing this, special care must be taken not to push the tube into a sort of pouch which always exists at the lower angle of the wound, between the trachea and the deep fascia of the neck. This error is not only embarrassing in the highest degree to the surgeon, but dangerous to the patient by the delay it occasions, by the compression exercised on the trachea below the opening into it, and by the suction of blood into the aperture in the air-tube. It is best avoided by expanding the tracheal opening with the dilator (Fig. 370), and passing the tube between the blades of that instrument. In the first instance, a tube of a conical shape should be employed, as it is not only introduced more readily than a cylindrical one, but fills up completely the aperture in the trachea, so as to prevent the draining of blood into the lungs. In passing the tube into the trachea some difficulty may be experienced, owing to the elasticity of the sides of the incision in the windpipe, in consequence of which one of them is apt to get doubled in under the end of the instrument. This may be avoided by the use

of Dr. Fuller's bivalve tube introduced by slipping a cannula into it (Fig. 369);



Fig. 368.—Bivalve Tube, closed. Fig. 369.—Bivalve Tube with Cannula introduced.

may be held aside with the forceps or a finger under the other. If the rings of the tube are not removed, the silver tube may most conveniently be cut by means of the trachea-forceps between or under their blades.

Some surgeons prefer, instead of the

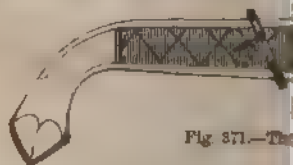


Fig. 371.—The trachea-tube.

cutting forceps (Fig. 371), or with a trachea-tube, which is there left in, though ingenious and in some respects so safe or easy of management, especially the trachea-hook.

Tracheotomy in Children is never an easy operation. The difficulty of the operation arises from the small size of the trachea, and the quantity of blood over it. The danger of the operation arises from the venous plexus in connection with the trachea. In performing this operation, an anæsthetic must always be administered. This may be done even if the most urgent asphyxia be present: the spasm, in great measure, is relieved by the anæsthetic. If not given, the struggles of the child will add much to the danger of the operation. The knife should be carefully placed on the medial line; and, when opened, the knife should be used as a lever, rather pushed and held aside with a finger. The trachea must be raised up by transfixion with the trachea-tube, the knife being neither thrust so deep

turned laterally. As soon as the trachea is opened, the tube should be introduced; and this step of the operation is greatly facilitated by holding the trachea well up and drawing it forward with the hook. When the tube is fairly in, the hook must be withdrawn.

COMPARISON OF TRACHEOTOMY AND LARYNGOTOMY.—On comparing tracheotomy as ordinarily performed, with laryngotomy, I think there can be little doubt that the surgeon should give the preference, in all cases where it is practicable, to the latter operation, on account of its greater simplicity, safety, and rapidity. In all cases in which the obstruction to respiration is produced by inflammatory effusion into the submucous cellular tissue, whether dependent upon idiopathic or erysipelatous laryngitis, œdema glottidis, or chronic disease of the larynx, or upon the irritation and inflammation excited by swallowing boiling water or the stronger acids, the swelling, for reasons that have already been mentioned, never extends below the true vocal cords; hence an opening into the crico-thyroid membrane will always be below the seat of obstruction. An objection, it is true, has been urged to laryngotomy in these cases, that it does not allow of the patient wearing a tube without much irritation being induced. This, however, I have not found to be the case in my practice. I have had patients who have worn silver tubes in this situation a considerable number of years, in one case as many as twelve, and in whom no special irritation has been occasioned by them. When the windpipe requires to be opened for the extraction of a foreign body, tracheotomy should be performed in preference to laryngotomy, as the latter operation does not admit of sufficient space for its expulsion or extraction. In children the larynx is so little developed, that tracheotomy becomes necessary.

In my opinion, laryngotomy is the operation that should, in cases such as above mentioned, be preferred in the adult; and this opinion is based on the following reasons.

1. As in laryngotomy the air-tube is always opened below the seat of obstruction, there can be no necessity to make an aperture farther from the seat of disease. In laryngitis, whether that affection assume the acute or the chronic character, the obstruction to breathing is in a great measure mechanical, and depends upon the infiltration of the submucous cellular tissue of the larynx, and partly of the large plane of this tissue, which lies behind the box of the larynx, and which, by expanding, as it were, into the pharynx, obstructs deglutition, and afterwards, by the extension of this swelling and infiltration to the lips of the glottis and the interior of the larynx, causes an impediment to the entrance of air into the bronchi. But, as has been pointed out by Mr. Prescott Hewett, this submucous cellular tissue terminates at the true vocal cords, where the mucous membrane becomes directly applied to the subjacent fibrous structures; the swelling and consequent mechanical impediment is hence confined to the limits of the thyroid cartilage, and any opening made below this will clear the lowest limit of the disease, which is always accurately and almost mathematically bounded below by the vocal cords. Hence an aperture in the crico-thyroid membrane is quite as effectual as one in the trachea.

2. Laryngotomy is a far safer operation than tracheotomy. On this point I need scarcely dwell; a glance at the anatomy of the parts concerned will be sufficient to establish it. The crico-thyroid membrane is nearly subcutaneous, and no parts of importance can be wounded in opening it, if we except the small inferior laryngeal artery, which crosses it, and which might be cut across, but from which I have never seen any trouble arise. The trachea, on the contrary, is not only deeply seated, but covered by a large

plexus of blood-vessels, which, when rendered turgid by the asphyxiated condition that exists when an operation is required, pours out a large quantity of dark blood, and thus seriously embarrasses and delays the surgeon at a time when the life of the patient depends on the speedy admission of air to his lungs.

3. Laryngotomy can be much more quickly performed than tracheotomy. This I look upon as an inestimable advantage in many of the cases requiring operation; a few seconds, more or less, being sufficient to turn the balance either in favour of life or of death. The rapidity with which laryngeal obstruction—partly mechanical and partly from spasm—sets in, is sometimes so great, more particularly when an acute inflammation supervenes on chronic disease of the larynx, that life may be extinguished before the surgeon has time to open the windpipe, if he endeavour to do so by tracheotomy. In extreme cases, as where the lungs have become slowly engorged, the action of the heart is already enfeebled, and a sudden spasm occurring at the glottis will at once place the patient beyond recovery. But, even though life appear for the moment extinct, it is the imperative duty of the surgeon to open the air-passages as speedily as possible, and to endeavour, by means of artificial respiration, to recall the flickering spark; and it is impossible to experience a greater satisfaction in the exercise of our profession, or to witness a greater triumph of art, than in thus snatching a patient out of the very jaws of death.

Laryngotomy should, therefore, be practised on the adult in impending asphyxia from the following causes:—1. Acute laryngitis; 2. Erysipelatous laryngitis—œdema glottidis; 3. Chronic ulceration and disease of the larynx; 4. Scald of the pharynx, &c., from swallowing corrosive liquids; 5. Spasm from pressure on the recurrent laryngeal nerve; 6. Diphtheritic exudation.

Tracheotomy should, as a general rule, be preferred in children, and should be performed on them for obstruction to respiration from—1. Croup; exudation; 2. Diphtheritic effusion; 3. Swallowing boiling water; 4. Foreign bodies in the air-passages; 5. Impaction of food, &c., in the pharynx.

TRACHEA-TUBES should be of such a calibre throughout as to admit of respiration being carried on through them, without any effort on the part of the patient. Many of those that are to be met with in the instrument makers' shops, though very wide at the mouth, are far too narrow and contracted at the lower aperture to allow a free and unimpeded passage for the air of respiration, being made very conical in order to admit of easy introduction, and to occlude completely the opening in the windpipe, so as to prevent the entry of any blood by the side of the tube. The disadvantages attending this mode of construction may in a great degree be remedied, by having a longitudinal opening like the large eye of a catheter cut in the mid of the tube, immediately above the inferior aperture.

One great difficulty which the surgeon has to meet in cases of tracheotomy or laryngotomy, is to keep the tube from being clogged and obstructed by mucus. It is usually stated that the tube may be kept clear by the occasional introduction of a feather, of a piece of sponge fixed to a stick, or a bit of lint wrapped round a probe. In this way it is true that the frothy or spumous mucus that collects in the tube may be readily enough cleared away; but this simple means will in very many cases be found to be quite ineffectual in removing another kind of mucus that in certain conditions rapidly accumulates to a considerable extent within the tube. On examining a trachea tube that has been worn for but a few hours, it will be found that its interior becomes gradually lined by a coating of dry, gummy, and very tenacious mucus, which is so firmly adherent to the metal as to render it

necessary, before the tube can be properly cleaned, to detach this lining by means of a penknife or pointed probe: or, what is better, by pouring boiling water through the tube. This tenacious mucus, collecting in largest quantity at the inferior aperture, and at the curve of the trachea-tube, may block up its calibre to a very great and dangerous extent, whilst the mouth of the tube appears to be perfectly pervious and free, and though feathers and pieces of stick, armed with sponge or lint, have been introduced from time to time; but these, passing over this dry mucus, are quite unable to detach it from the side of the tube, and merely bring away the sputa and more frothy mucus.

Mr Obré has devised a very simple means to remedy this inconvenience. It consists in the trachea-tube being made of uniform calibre throughout, and having an interior tube accurately fitted to it, and projecting about one-eighth of an inch beyond the lower extremity of the outer tube. It is in the projection of the internal tube beyond the lower end of the external one that the great utility of this contrivance consists. If the two tubes be of the same length, or still more, if the innermost tube be the shorter, a plug of mucus may be left at the end of the outer cannula, on the withdrawal of the inner tube. But if this be the longer of the two, the end of the outer tube will be effectually cleared every time it is withdrawn, which may be done as often as any mucus collects, without in the slightest degree disturbing the patient. The two tubes are fixed by means of a button, attached to the edge of the outer one (Figs. 372, 373). The bivalve trachea-tube (Figs. 368, 369)



Fig. 372—Trachea tube, Side view



Fig. 373.—Trachea tube, Front view



Fig. 374—Laryngeal Tube.

is constructed on the same principle, the inner tube being longer than the outer; and possesses the additional advantage of being readily removed for the purposes of cleaning, and as easily replaced. When used for laryngotomy, the tube may conveniently be curved on the flat (Fig. 374): the longest diameter being lateral instead of antero-posterior, thus being adapted to the form of the aperture in the crico-thyroid membrane.

TAPPING THE CHEST.

Paracentesis Thoracis may best be done with an ordinary trochar of moderate size; and the most convenient spot for the puncture is usually the side of the chest in the fifth intercostal space, at the line of insertion of the serratus magnus. The skin having been punctured with a scalpel, the trochar should be pushed over the upper margin of the sixth rib into the middle of the space, so as to avoid the intercostal artery, and must then be thrust sharply and boldly into the pleural sac, so as to make sure of perforating the thickened pleura or any false membranes that may line its interior, and which, if the instrument be pushed slowly on, might be carried before it and thus prevent the escape of the fluid. Air may in this operation

gain entrance into the pleura, and, decomposing the fluid, become a source of constitutional irritation. In order to obviate this inconvenience, the instrument figured in the accompanying sketch (Fig. 375) will be found



Fig. 375 — Trochar for Tapping the Chest.

useful; the trochar having been introduced, and the stop-cock shut as the piston-stylet is withdrawn, a bladder is attached to the end of the cannula, and when this has been filled the stop-cock is again closed, the bladder emptied and re-applied (Fig. 376). Or, if the surgeon prefer it, he may attach



Fig. 376.—Paracentesis Thoracica.

a long vulcanised India-rubber tube to the cannula, leaving the free end in a basin of water, into and under which the pleuritic fluid may be drawn off without the possibility of air being sucked into the chest. By one or other of these methods, as much of the fluid as is desired may be safely removed. The quantity that may be drawn off is often very considerable. I have removed from 40 to 50 ounces from the chest of a child four years of age, and from the adult as much as 90 ounces. After the withdrawal of the cannula the puncture is closed by a pad of lint, strapping, and bandage, and will, if the fluid have been serous, usually readily unite. After tapping the lung will either expand and fill up the cavity previously occupied by the fluid; or, if adhesions prevent this, the thoracic parietes will gradually collapse.

If the accumulation be an *empyema*, the cannula or an elastic tube may be left in the chest, and the pus drawn off, or removed as it re-accumulates; or a gum catheter or drainage-tube may be left in, and the pus allowed to drain off as fast as secreted. Should air have got admission into the pleural sac, it will be necessary to make the opening free, so as to secure a ready exit for the fluid, lest putrefactive changes ensue in it. In *hydrothorax*, however, it is of great consequence to prevent the entrance of air; and here every precaution to this end should be taken.

In *Hydrops pericardii*, the pericardium may be tapped by making an incision through the skin and cellular tissue in the fifth intercostal space, and then puncturing the membrane, with a fine trochar at that point where palpitation and auscultation have indicated the greatest amount of fluid. The trochar should be passed obliquely.

Drainage-Tubes.—Dr. Goodfellow and Mr. De Morgan have advantageously adopted the use of Chassaignac's drainage-tubes in the treatment of empyema, with the view of preventing the accumulation of pus, its fetid decomposition, and consequent irritative fever, and of allowing the gradual expansion of the previously compressed lung, or collapse of the chest-wall.

The mode of introducing the drainage-tubes into the pleural sac, adopted by De Morgan, is the following. A puncture with a trochar having been made in the usual situation between the fifth and sixth ribs, a long iron probe, slightly bent, is passed through this opening, and pushed downwards and backwards. It is then made to press against the thoracic wall at its lower and posterior part; and, being felt through the intercostal space, it is cut down upon, and its end exposed. A silk thread carrying the drainage-tube is now passed through the eye of the probe; and as this is drawn out at the lower opening, the thread and tube necessarily follow. The ends of the tube projecting from the opposite openings are then tied together, leaving the body of the tube in the pleural sac. The pus drops out as it forms; and thus the chest is kept empty by drainage through the tube and the lower counter-opening.

CHAPTER LX.

DISEASES OF THE BREAST.

DISEASES of the *Breast*, when they occur in the female, are of much interest to the surgeon; not only on account of their great variety, but from the difficulties attending their diagnosis, and from the importance of determining the question of operative interference in connection with them.

Diseases of the breast seldom occur before puberty, being most frequently met with either during lactation, when the functions of the gland are in a high degree of development; or towards the termination of menstrual life, when the actions of the organ are necessarily influenced by the changes that are taking place in the uterine system. Before puberty, the breast occasionally but rarely becomes the seat of inflammation and abscess; in all probability accidentally, these changes taking place in it in the same way that they might in any other part of the body. More serious disease has, however, been met with in the mammary gland, even at this very early age; thus, Lyford has recorded a case of cancer of the breast in a girl of eight. As the period of puberty approaches, the breasts often swell, become hard, knotty, and somewhat painful, indicative of some commencing change in the generative system. In other cases again, a precocious hypertrophy may take place, frequently attended with severe neuralgia in the part. When puberty occurs, the breasts naturally enlarge, and often become tender; and occasionally one undergoes a certain degree of hypertrophy, increasing greatly in bulk beyond the other. These various changes, though exciting

alarm in females, cannot be regarded as of great importance, and seldom require more than the simplest surgical treatment.

ANOMALIES OF DEVELOPMENT

The mammary gland is subject to certain anomalies. Thus, in some instances it has been found to be absent. Cooper and Froriep both relate instances in which it was undeveloped, and in which the ovaries were also undeveloped. An anomaly consists in the development of a number of breasts. Birkoitt has collected fourteen reported cases, in which there were two breasts; more frequently there is but one breast, sometimes two; and occasionally, though very rarely, more than two, constituting quintuple mammae. *Supernumerary* breasts are found to occur; two to each breast have been found communicating with the gland, and passing milk. Most of these breasts are situated somewhere in the neighbourhood of the axilla, on the anterior part of the thorax; and where they have been found placed in two parallel rows, one above the other. They have been met with in very strange situations, as seen on the outer part of the thigh, in the arm, &c. In children have even been known to have been present at birth.

NEURALGIA.

NEURALGIA OF THE BREAST occasionally occurs, and may constitute a positive disease, either in girls or in women of mature life, when it not unfrequently complicates other diseases of this organ. It is especially apt to occur in females of the hysterical temperament, though it is also met with in ruddy-looking women, who are perhaps subject to it in the back, and in other situations. Most commonly it is irregular; and uterine congestion, inflammation, &c. discovered on examination; indeed, of late, at least in this country, has been drawn to these affections, and it is not difficult to detect one or other of these conditions in the breast.

Symptoms.—In neuralgia of the breast the breast is of normal size and consistence; but in some instances it is more or less indurated and hypertrophied. There is a constant and aching, deeply in its substance, with cutting and lancinating or radiating sensations that extend to the arm. These painful sensations are constant, and are not menstrual period, and not unfrequently alternate with it.

Diagnosis.—The diagnosis of this affection is not difficult, many disease may usually be effected by attending to the radiating character of the pain, to the temporary nature of it occurs, to its shifting seat, and to the absence of any disease in the breast.

Treatment.—The treatment consists especially in the regulation of the uterine organs; unless this be done, the disease will prove to be excessively rebellious and troublesome. The speculum, however, when necessary, and in cases of any uterine irritation that may be found, this is the best remedy, with greater readiness than by any other plan of treatment.

antihysterical constitutional remedies may be employed ; the preparations of iron administered, when necessary ; and the local pain relieved by the application of belladonna and opiate plasters, or by inunctions with atropine ointment.

HYPERTROPHY.

SIMPLE HYPERTROPHY OF THE BREAST is not unfrequently associated with very severe neuralgia of the organ. An increase of size, such as naturally takes place during pregnancy, between the fourth and the ninth months, will occasionally commence at puberty, and go on until the organ attains an enormous bulk, as in Fig. 377, which represents the breast of a girl of fifteen, who was under my care for this condition. In some cases the breast has been found after death to weigh as much as twenty pounds ; and after removal, a breast of this kind, taken from a young woman under thirty, has weighed no less than twelve pounds, being entirely composed of its normal tissues, greatly hypertrophied. In these cases of hypertrophy both breasts are usually affected, though one is commonly more so than the other. When first this morbid condition commences, the breast preserves its usual shape, though it is increased in bulk ; but as it enlarges it gradually projects forwards, drawing down the skin of the shoulders, of the sides of the chest, and even of the back, and hanging downwards until, as in a case mentioned by Bérard, it has been known to reach to the knees.



Treatment.—The treatment of this Fig. 377.—Simple Hypertrophy of Breast in a Girl fifteen years old.

affection is very unsatisfactory. The general health must be attended to, and an endeavour may be made to excite lactation, and thus to unload the vessels of the breast by the employment of galactagogue remedies. I do not think that amputation of the organ should be performed in these cases unless the growth attains so great a size as to render life a burden.

LOBULAR HYPERTROPHY OF THE BREAST has been described by Sir A. Cooper as occurring chiefly in unmarried women between thirty and forty years of age. It appears on manipulation to be composed of several solid but moveable masses, which after a time begin to diminish in size, until the breast at last atrophies, and is in a great measure absorbed. It seems to me to be rather a species of the chronic mammary tumour than a pure hypertrophy.

ABNORMAL CONDITIONS OF THE LACTEAL SECRETION.

The lacteal secretion is occasionally the cause of abnormal conditions in the breast. Thus the milk may appear at *unusual times*, a twelvemonth, for instance, after weaning ; it has occasionally been known to be secreted in children, and in some remarkable instances in men. In other instances

again, after parturition, there is a total *Absence of Milk*, either owing to want of development in the gland, or to debility on the part of the mother. The opposite condition will occasionally occur, and an *Excessive Flow of Milk* may continue in hysterical females after the child has been weaned. In such cases as these, the *galactorrhœa* may be checked by the application of the extract of belladonna to the breast, aided by the employment of tonics, the administration of acids, &c.

LACTEAL TUMOUR.—It may happen during lactation that one of the lactiferous ducts becomes obstructed, either by its being obliterated by inflammation or occluded by the deposit in it of a small concretion—a lacteal calculus. In either case the walls of the duct may be expanded, so that at last it constitutes a moderate-sized cyst, fluctuating on pressure, and evidently containing fluid. In some cases, the lacteal tumour has been known to attain an enormous size. Walpy has related a case in which he drew off ten pounds of milk by tapping a collection of this kind. These tumours may exist for a considerable time. Dupuytren records an instance in which one had existed for ten months, and Cooper one of a year's duration. In these chronic cases the milk usually undergoes changes, becoming creamy, thick, and oily; and in some instances it would appear to leave a solid residue by the absorption of its watery parts. In other instances the milk appears as if diffused through the substance of the gland and its ducts, constituting a spongy semi-fluctuating tumour. Velpeau has pointed out that these lacteal deposits undergo a series of changes, somewhat similar to those that take place in blood that has been extravasated; becoming absorbed in whole or part in some instances, in others remaining fluid, and in others becoming encysted.

Treatment.—In these cases, the readiest mode of getting rid of the tumour is, as Sir A. Cooper advises, to make an oblique puncture from the nipple towards it, by means of a trochar and cannula, so that a fistulous track may be left, along which the milk is discharged, and thus got rid of; the child being at the same time weaned, so that the secretion may cease.

In some cases after weaning, the milk may be diffused into the substance of the gland or collected into masses of curd, forming hard nodules, which give a good deal of trouble, and may eventually go on to some of the forms of inflammation that will immediately be described; these swellings are usually best removed by frictions with somewhat stimulating embrocations such as camphorated oil, &c., by which their absorption is promoted.

INFLAMMATION OF THE BREAST.

Inflammation of the Breast may take place at any period of life, but is usually associated with that change in the function of the gland which occurs during lactation. It is commonly met with during the first month or two after the birth of the child, and seldom occurs during weaning, but may, as Nunn has shown, be the consequence of unduly prolonged suckling, and thus appear at a late period—the tenth or eleventh month. It is more frequently met with in weakly phlegmatic women. The inflammation may affect any one of the constituents of which the breast is composed, and may be limited to this; thus it may take place in the nipple, in the subcutaneous cellular tissue lying between the skin and the gland; in the gland itself; or in that extensive plane of cellular membrane upon which the gland rests, and which intervenes between it and the pectoral muscle. But although the inflammation commonly affects these different parts, in many cases the whole of the breast appears to be affected, and no distinct implication of any special tissue can be made out.

INFLAMMATION OF THE NIPPLE AND AREOLA usually occurs at an early period of lactation in delicate women, and especially with the first child. It commences with the follicles of the part, being accompanied by superficial suppuration, abrasion, fissure, and cracks, with oozing of a small quantity of serous, sero-puriform fluid, great pain during suckling—so great, indeed, as to prevent the proper continuance of this act; and it is usually attended by a good deal of constitutional irritation. In some instances, the fissured state of the nipple would appear to precede the setting in of inflammation; in other cases, the inflammation is the primary condition. When the areola and nipple are inflamed, these parts become conical, red, and swollen, with much pain, owing to the density of the subcutaneous tissue in this situation.

Treatment.—When this disease, commonly called *cracked nipple*, has set in, most relief is afforded by the application of the nitrate of silver to the bottom of the fissures, and over the inflamed surface. This application, though painful at the time, gives the patient afterwards more complete ease than any other with which I am acquainted. In some instances the application of the citrine ointment, and in other and slighter cases that of collodion, is useful. When inflammation exists, with superficial abrasion, but without any distinct crack, the employment of astringent applications, such as the tinctures of myrrh and of catechu, borax and honey, or spirit and water, may be useful. In these cases also a leaden nipple-shield may be employed with advantage, and the state of the infant's secretions should be carefully attended to: the occurrence of aphthous ulcers in the mouth being followed with especial frequency by the disease in question.

Abscess of the Areola not unfrequently occurs in suckling women, with the ordinary signs of local inflammation, terminating in circumscribed suppuration. The *Treatment* consists in the application of warm poultices made with lead lotion, and lancing the part early. In doing this, care should be taken that the cut be made from the centre of the nipple towards the circumference of the areola, so as not to divide the lacteal ducts.

INFLAMMATION OF THE BREAST, which, as it generally terminates in suppuration, is usually called *Milk Abscess*, may occur in three situations: 1, in the Subcutaneous Cellular Tissue, *Supramammary Abscess*; 2, in the bed of Cellular Tissue in which the Mammary Gland is lodged, *Submammary Abscess*; and 3, in the Gland itself, *Mammary Abscess*.

1. *Inflammation, followed by Abscess of the Subcutaneous Cellular Tissue of the Breast*, though commonly occurring during lactation, is more frequently met with than any other form of inflammation in this region at other periods of life, more particularly about the age of puberty. Its symptoms are those of simple phlegmonous inflammation, differing in no way from abscess of this kind in other situations, except that it is always distinctly circumscribed.

2. *Inflammation in the Cellular Plane between the Mamma and the Pectoral Muscle* diffuses itself over the whole of the cellular layer, and almost invariably runs into abscess with considerable rapidity, giving rise to great pain in this situation of a deep, heavy, and throbbing character, much increased by moving the arm and shoulder, and attended by swelling, oedema, and a slight red blush upon the skin. The breast becomes prominent, is conical and projecting, the whole organ being pushed forwards by the pressure from behind; it is not readily moveable on the pectoral muscles, and the subcutaneous veins become engorged, and at last abscess forms. It is not always easy in these cases to determine whether suppuration has taken place or not, the depth at which matter forms rendering it impossible in the early stages to detect fluctuation until it approaches the surface; its presence

may, however, be suspected on the occurrence of deep-seated throbbing pain, œdema, and some superficial redness. The abscess at last points at some part of the margin of the gland, usually at its lower and outer side, where the matter seems to gravitate, after a time, however, it will commonly appear at other points of the circumference of the gland, beyond which it always extends, though it seldom, if ever, perforates the structure. I have, in more than one instance, seen a series of four or five apertures, forming a large circle round the margin of the gland. It very commonly happens that the apertures through which the pus discharges itself in these situations, degenerate into fistulous canals, by no means easily closed.

3. *Inflammation of the Mammary Gland* itself is not of such frequent occurrence as either of the other forms of abscess. When the whole of the organ is affected, it gives rise to great swelling of the breast, with severe aching and lancinating pain, and much constitutional disturbance, usually of an irritative type. Not unfrequently one lobule only of the gland becomes inflamed; and then the local signs are proportionately limited, and occasionally cease. As Velpeau has pointed out, one lobule after another may become inflamed, so that a succession of abscesses forms in different parts of the gland. As the inflammation advances to suppuration, the skin is reddened, assumes a dusky hue, becomes glazed, has a peculiar greasy appearance, and pits on pressure. When matter has formed, the tension of the superficial parts, with œdema and perhaps deep-seated fluctuation, determine its presence.

Treatment.—In the treatment of inflammation and abscess of the breast occurring during lactation, it must be borne in mind that we have not a sthenic inflammatory condition to deal with, but that the disease almost invariably happens in pale delicate women, commonly of a strumous habit, and weakened by recent parturition; indeed, the affection appears to be rather an inflammation of an irritative and congestive, than of a sthenic character. It is therefore obvious that antiphlogistic means of an active nature are not admissible; and the best plan of treatment appears to consist in keeping up the strength of the patient by proper constitutional support, at the same time that the local inflammation is checked by topical antiphlogistic measures. The first thing to be done is to prevent the occurrence of suppuration; if this can be accomplished, which is, however, rarely the case, much will be gained. In order to effect this, the breast should be supported in a sling, so as to lessen congestion in it; and the arm at the same time should be fixed to the side, in order to prevent traction of the pectorals and movement of the submammary cellular tissue. If the patient's strength be good, leeches may be applied; in the majority of cases, however, they will not be required, but warm evaporating lead lotions or the assiduous application of camomile or poppy fomentations may be substituted in their stead; at the same time, the milk should be drawn off by means of a breast-pump or sucker, the child being put to the unaffected breast or weaned, and an occasional saline purgative administered. When suppuration is impending, the application of fomentations may be continued, the patient being allowed a more liberal supply of nourishment, with a moderate quantity of malt liquor; and, so soon as matter can be felt, it should be cut down upon and let out by an aperture in the most dependent position. It is of great importance that the matter should be let out early, and by an opening into the lowest part of the abscess: if it be not, it burrows deeply, diffusing itself through the cellular tissue under, behind, and around the gland, and, opening at several points, leaves long fistulous tracks perforating the breast in various directions. When suppuration is

ing on, the patient's strength must be supported with tonics, the mineral acids, bark, and quinine. Porter must be liberally allowed, and plenty of nourishment given. The sinuses that are left may usually be induced to close by attention to the state of the general health: should they not do so, however, the employment of pressure and the use of stimulating injections may, at a time, accomplish this. In the event of their proving rebellious, it has been proposed to slit them up; but this is an unnecessarily severe practice, and may, I believe, in all cases be dispensed with.

CHRONIC ABSCESS OF THE BREAST may assume two forms: the *Diffused*, and the *Circumscribed or Encysted*.

Chronic Diffused Abscess of the breast may occur at all ages, in the single or in the married. It usually appears in the submammary cellular tissue, often without any external exciting cause, but as a consequence of impaired health, in atrophic or cachectic females, and is possibly connected with uterine derangement. It may acquire a very large size, and, pushing the mammary gland before it, gives the breast a conical-pointed shape. Fluctuation soon becomes apparent, and the ordinary local signs of chronic cold or congestive abscess disclose themselves.

The *Treatment* of chronic diffused abscess of the breast consists in making a free outlet for the pus in a dependent situation, and then introducing a drainage tube; at the same time that the general health is improved with iron or cod-liver oil on ordinary medical principles.

Chronic Encysted Abscess of the breast is a disease of great importance, inasmuch as it closely simulates various tumours in this situation; so much so, indeed, that it is only with extreme difficulty that the diagnosis is effected in some cases, and the breast has in numerous instances been amputated on the supposition of its being the seat of tumour, when it was merely affected with this variety of abscess. It usually commences as the result of pregnancy, whether complete parturition or miscarriage takes place, sometimes as a consequence of lacteal inflammation, but usually without any injury or other direct local cause. An indurated indolent swelling forms, and this may gradually soften in the centre; but fluctuation may for a long time be very indistinct, and even absent, being obscured by the thick wall of plastic matter that is thrown out around the collection of pus. It is owing to the deposition of this dense mass of limiting fibrine, that the encysted abscess is commonly developed as a hard and apparently solid lump. It is in general not very distinctly circumscribed, and of but moderate magnitude; after a time it remains stationary, or but slowly increases with but little pain during a space of many months; it is not unfrequently attended with retraction of the nipple.

Diagnosis.—The diagnosis of this form of abscess is of great importance, inasmuch as it has not unfrequently been excised for *tumour* of the breast. I am acquainted with many instances in which this mistake has been committed. Such an error may, however, commonly be avoided by attention to the following points: 1, that it is almost invariably preceded by impregnation, parturition, or miscarriage; 2, that there is more or less oedema of the subcutaneous cellular tissue covering it; 3, that, although it is of slow formation and without pain, it is not distinctly circumscribed, but gradually fuses in an irregular manner into the neighbouring tissues; 4, that it is not freely moveable, but rather incorporated with adjacent parts; and 5, that elasticity, or even deep fluctuation, may be commonly felt at one part of it. Should there be much doubt in the case, the introduction of a grooved needle, by giving issue to the pus, will always determine its true nature; indeed, this simple means of diagnosis should never be neglected in all cases in which

there is reason to suspect the possibility of the apparent tumour of the breast being in reality an abscess.

Treatment.—In encysted abscess, as well as in the diffused form, the drainage-tube is most useful; but should the mass of plastic matter be very large and dense, a seton may advantageously be passed across it in a perpendicular direction, so that the tumour may be softened down and caused to disappear by the inflammation thus excited in it.

In all cases of chronic abscess of the breast, but more particularly in the submammary, the arm should be kept in a sling or bandaged to the side.

TUMOURS OF THE BREAST.

The study of the various tumours of the breast, more especially in a diagnostic point of view, is of the first importance to the practical surgeon; for, though it might be supposed that it would be easy, if not to recognise the minuter shades of pathological difference between morbid growths so superficially situated as those of the mammary gland, at all events to diagnose the malignant from the non-malignant affections of this organ, yet in practice nothing is more difficult in many cases: and it not only requires great experience, but also an intimate acquaintance with the special course and symptoms of each particular disease, to come to a correct conclusion as to its nature. Even with all the light which experience and a careful examination of the characters of the tumour may throw upon the nature of the disease, it will be impossible for the surgeon to avoid occasional errors in diagnosis.

NON-MALIGNANT TUMOURS.

Mammary tumours may be either simple or malignant. The recognition of the different varieties of simple tumour that affect the breast-gland, is principally due to Sir A. Cooper; and this department of surgical pathology has of late years been much extended by the researches of Velpeau and Birkett. The non-malignant tumours of the breast comprise the *Chronic Mammary Tumour*, the different varieties of *Cystic Growth*, the *Painful Tubercle*, *Hydatid Cysts*, and various forms of *Fibrous*, *Cartilaginous*, and *Ossaceous Growths*.

CHRONIC MAMMARY OR ADENOID TUMOUR is perhaps the most common variety of these benign structures. It usually occurs as the result of blows, squeezes, or lacteal irritation, and is almost invariably met with in young women under thirty years of age—seldom, if ever, commencing at a later period than forty; usually in persons otherwise healthy; and most frequently in those of a sanguineo-nervous temperament. This tumour is generally of small size when first perceived, and may remain stationary for many years, or it may slowly increase, and at last attain a considerable bulk. In other cases it may very rapidly grow to a great size. In a case on which I operated some years ago, the tumour had continued for eighteen years of about the size of a walnut, but in the course of six months it increased to an enormous magnitude, and on removal weighed nearly five pounds.

This tumour usually commences as a small, moveable, finely nodulated growth, attached by a pedicle to one side of the mammary gland; it is hard and incompressible, often appears isolated, and is not generally painful, it increases slowly, without discolouring the skin or becoming attached to it, and is frequently many years in attaining a moderate size. It is often floating, as it were, in the substance of the gland, into which it can be pushed back. This tumour is frequently mistaken for a cancerous growth, and the diagnosis is often as difficult as it is important; though in many cases the

otherwise good health of the patient, the mobility of the mass, the absence of all implication of the skin or glands, the want of hardness, and its circumscribed character, will usually indicate its true nature.

On examination after removal, it appears irregularly lobulated, is encapsulated, and its cut surface will be found to present a bluish or greyish-white colour, which, after exposure to the air, assumes a rosy tint; and, on pressure, drops of a thick creamy fluid will often be seen to exude. Under the microscope it has been found by Burkett to consist of imperfectly developed hypertrophy of the glandular tissue; the terminal cells of which are filled with epithelial scales.

Treatment.—This consists in attention to the general health, and in the employment of local absorbent remedies. In this way, tumours of this description have occasionally disappeared; in some instances, they have been known to become spontaneously absorbed after marriage or during pregnancy. If obstinate, their dispersion may be facilitated by the occasional application of two or three leeches, followed byunction of iodide of lead ointment; and by the internal administration of Plummer's pill, and the compound decoction of aloes. In addition to these means, the employment of compression will be found especially serviceable; this may be applied either by means of Arnott's slack air-cushion, or by Tauchou's plan, which consists of a pad to which a spiral spring is attached, and which, being compressed by a proper arrangement of bandages across the chest, will keep up steady and continued pressure upon the tumour. I have employed this kind of apparatus, which is far less expensive and cumbersome than the air-compressor, in several cases of mammary tumour, with great benefit. The advantage attending it is, that it can be used in conjunction with absorbent ointments, which cannot be used with the air-bag, as the grease entering into their composition destroys the macintosh cloth of which it is made. In this way absorption may not unfrequently be secured; and I am disposed to think that not a few of the so-called cases of cancer of the breast that have been reported as having been cured by pressure, were in reality instances of the chronic mammary tumour in which absorption had been brought about in this way. Should the growth attain too great a magnitude to admit of absorption by the means that have just been recommended, its excision must be practised. In doing this it is not necessary to remove the whole of the breast, but it will be quite sufficient to extirpate the tumour itself, and at most the small lobe of mammary gland connected with it. This may be done, if the growth implicate the edge of the mammary gland, by two incisions that radiate from the nipple as from a centre, thus inclosing a triangular portion of the breast. If it be very moveable, and in the substance of the gland itself, it may often be enucleated through a simple incision. In removing this tumour there are two little practical points that should, if possible, be attended to. 1. The gland should not be incised through its whole thickness, so as to open up the cellular bed which is interposed between it and the pectoral muscle. If this be interfered with, infiltration of blood or of pus into it may occur, and deep abscess may form under the breast or at the lower edge of the gland, leading to very troublesome consequences. 2. The wound must not be closed tightly by sutures and plasters. If this be done, the discharges are retained, and burrowing of unhealthy matter often results. I have found it better to leave the wound open, and to dress it from the bottom.

When the tumour has been allowed to attain a very large size before removal, it will generally be necessary to extirpate the nipple and the whole of the mammary gland, which will be found, perhaps, in an atrophied but

otherwise healthy state. The largest tumour cystic development, which I have had occasion to remove, weighed five pounds.

In some rare cases, adenocoele, without any other disease, after operation, even though the whole of the breast is extirpated with the tumour. In one case, where the adenocoele weighed about four pounds, with a contracted and atrophied mammary gland, from a lady who had a recurrence took place in 1861, and again in 1862, were developed at some little distance from the site of the first operation proved on careful examination to be purely a new formation.

PAINFUL MAMMARY TUMOUR.—It occasionally happens that a mammary tumour becomes the seat of a neuralgic pain, attended with very considerable distress, constituting the form of disease that goes by the name of *neuralgic mammary tumour*. This condition most frequently occurs in women of an irritable and delicate constitution, and is attended with disorder of the uterine functions, the pain recurring at the menstrual periods, and appearing to be essentially owing to the twigs of the intercosto-humeral nerves in the axilla.

The *Treatment* of this affection must have regard to the neuralgic condition. This is commonly treated by the administration of alteratives and tonics, more especially of iron and zinc, with cod-liver oil if necessary. The iodide of lead ointment, conjoined with the use of the affected breast. In many cases the pain subsides from time to time, especially in the winter months, the neuralgia more effectually than any other remedy. In others, again, pressure will be found serviceable, and the excision of the tumour may in this, as in the case of the neuralgia, be necessary.

CYSTIC TUMOUR OF THE BREAST is one of the most common malignant affections of this organ. It may be divided into 1. As a *Single Unilocular Cyst*; 2. As several small cysts, together, a *Compound Cyst*; and 3. As the *Hydatid Cyst*, in which the cystic development appears to be analogous to that of the chronic mammary tumour. In the case of non-malignant cystic tumour, we occasionally meet with the breast.

1. *The Single or Unilocular Cyst* of the breast is sometimes called by Sir B. Brodie as the *Sero-cystic Tumour*, and by others as the *Hydatid tumour*, usually occurs in the form of a swelling of the size of a filbert, containing a clear serous fluid, and is moveable under the skin. When more than one cyst of this kind is present in the breast, the disease is called *Compound Cyst*. In the greater development than the others, the cyst is more difficult to detect. These cysts, when single and small, contain a clear fluid, but as they increase in size, or become compound, they assume a greenish-brown or blackish tinge from the presence of blood. They continue for a great length of time of small size, and then gradually increase until they contain several ounces of fluid, become very tense, with the skin drawn tight, and the areolæ shining. Sir B. Brodie is of opinion that

distention of the lactiferous tubes, and refers to a preparation in which this position can be demonstrated.

The *Diagnosis* of the affection may usually be readily effected by feeling a globular elastic cyst or cysts under the skin; the mammary gland being movable, and not adherent to any of the adjacent structures. In those cases, however, in which the tumour lies deeply, the diagnosis may not so easily be made, more especially from some of the cystic forms of cancer to which I shall afterwards have occasion to advert. In fact, nothing is more easy than to diagnose the true nature of a superficially seated cystic tumour, — nothing more difficult in some cases than to diagnose one deeply seated at the under surface of the mammary gland. Whenever the surgeon has any doubt about the existence of fluid in a tumour of the breast, he should introduce an exploring trochar; when, if the disease be cystic, the fluid will be discharged. If the tumour prove to be solid, no ill consequences will result from the simple puncture. Several instances have occurred to me in which, from the want of this simple precaution, very excellent surgeons had condemned, as cancerous, tumours of the breast which proved to be cystic.

Unilocular cysts of the breast occasionally attain an immense size, at the same time that their walls remain thin and supple. In some of these instances, the fluid continues to the last of a truly serous character; in other cases, however, it becomes more or less glairy or mucilaginous, and hence Velpeau has described this variety as the *Sero-mucous Cyst*. In other cases the walls of the cysts have been known to undergo calcareous degeneration. When these cysts attain a very large size, their walls being thin, and the skin covering them tense, they may become translucent, and thus constitute true hydrocele of the breast, resembling in many respects similar serous tumours that form in the neck.

2. *Compound Cysts*.—In the majority of instances, as has already been observed, no material alteration takes place in the cyst, except, perhaps, its gradual increase in size; but in other instances, peculiar changes occur in it, in consequence of which it becomes filled up by a dense solid growth springing from the interior, at last undergoing ulceration, and giving rise to a series of destructive changes. The pathological phenomena that accompany these changes have been ably investigated by Sir B. Brodie. He finds that, in the first instance, one or more membranous cysts, containing serum, are formed in the breast; the fluid gradually becomes darker in colour, and opaque; after a time a fibrinous excrescence, of a lobulated or foliated form, springs up into the interior of the cyst, gradually displacing and occasioning absorption of the contained fluid, and at last filling up the whole of its interior; and then, coming into contact with the capsule by which it is compressed, or with which it may be firmly incorporated, the whole tumour is converted into a solid mass, in which the remains of the cysts still continue to be perceptible. Sir B. Brodie thinks that there is reason for believing that a growth of a fibrinous substance takes place from the outer side of the cyst as well, thus adding to the general size of the breast. If one of the larger cysts be laid open, or if the pressure of the intracystic growth cause inflammation and ulceration of its capsule, this may at last be perforated, and a fungous mass will sprout through it, presenting many of the ordinary symptoms of a malignant growth; being irregular, dark-coloured, bleeding readily, and increasing rapidly in size, and indeed, in some cases, actually undergoing encephaloid transformation. When such changes as these have taken place, the tumour assumes a formidable character, and will rapidly prove fatal by the induction of exhaustion and hectic. Tumours

of this description, composed of cysts having intracystic growths sprouting from their interior, may attain an immense magnitude and weight. They have been met with of six, eight, or even twelve pounds weight; but the largest is one described by Velpeau, which weighed forty pounds.

3. *Cystic Sarcoma.*—The various forms of cystic tumour that have just been described, when associated with the development of fibrous intracystic matter, constitute forms of the so-called *cystic sarcoma*. Another variety of this disease, however, is not unfrequently met with, in which the sarcomatous or solid element of the tumour preponderates over the cystic part of the growth. In these cases the tumour will be found to be composed of dense, white, lobulated, or foliated structure, closely resembling that of the chronic mammary tumour, and consisting either of imperfect hypertrophy of the breast-gland, or of the deposit of a fibrous material. This mass is studded throughout with a number of small cysts, varying in size from a pin's head to a hazel-nut, and usually containing clear fluid. If some of these cysts increase out of proportion to the rest, the tumour will assume more of the true cystic character.

This form of cystic sarcoma usually occurs in women from thirty to thirty-five years of age, as the result of injury or as the remote consequence of some inflammatory action during lactation. On examining a breast affected in this way, it will be found that the tumour, which may either be confined to one lobe or may implicate the whole of the gland, is hard, heavy, and solid to the feel; on careful examination, however, its surface may be found to be finely nodulated; and, occasionally, a larger cyst than usual may be found projecting, which is recognised by its elastic feel and globular shape. The disease is slow in its growth, and does not implicate the adjacent cutaneous or cellular structures; hence, the tumour is movable on the pectoral muscles, and the skin is unattached to it. The axillary glands, also, are not enlarged, at least not to any material extent. The nipple is usually be found to be normal in its shape, and not depressed.

The eventual development of malignant action in these cystic tumours, and the deposit of encephaloid matter in the interior of the large cysts, must not be overlooked. A tumour of this kind may be benign for many years, and remain generally so throughout the greater portion of its structure; yet, after removal, encephaloid may be found to have formed in some of the cysts. In the case from which the following drawings (Figs. 378, 379) were taken, the tumour had existed for more than twenty years before removal, having commenced at the age of twenty-eight; but, after extirpation, cancerous encephaloid matter was found at the bottom of some of the cysts, which, as the constitution was uncontaminated, was doubtless of recent formation; and the surface of the fungus was epitheliomatous.

Treatment.—The treatment of these various forms of cystic and sarcomatous growths varies, according to the number and size of the cysts, and the quantity of solid matter deposited inside and around them. When the cyst is small and single, the fluid contents may be let out by puncturing with a small trochar; but a cure cannot usually be effected in this way, as the fluid readily reaccumulates. In cases of this kind, Sir R. Brodie found considerable advantage from the application of stimulating embrocations, more particularly of one composed of equal parts of camphorated spirit and weak spirit, with one-eighth part of liquor plumbi. In other cases, blistering and the application of the tincture of iodine may be serviceable. Under these plans of treatment, I have several times seen the tumour disappear. Occasionally it will suppurate spontaneously, and is thus got rid

if; or it may be opened, a tent of lint introduced, and thus suppurative granulation established in it.

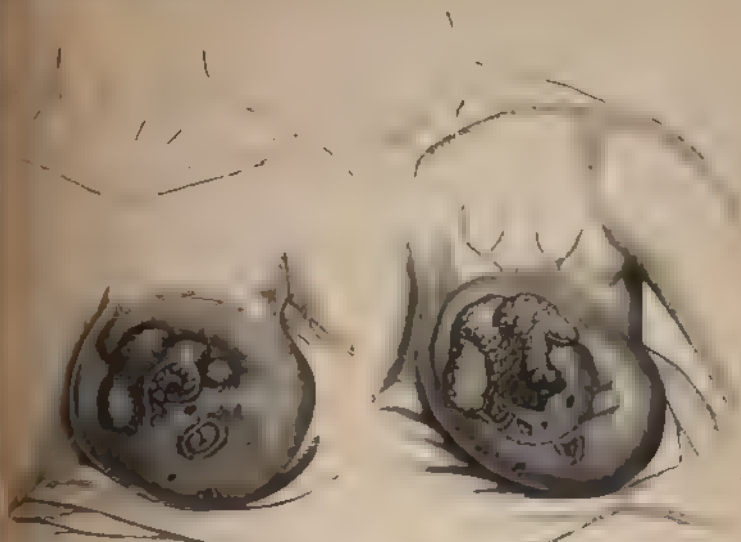


Fig. 378.—Ulcerated Cystic Tumour of Breast, of 20 years' duration.

Fig. 379.—The same Cystic Tumour, six months later, with Cancerous Deposit.

Operative Treatment.—If the tumour be unilocular and single, containing serous fluid, possibly with fibrinous matter in its interior, it may often be dissected out of the cellular bed in which it lies, and be separated from its attachment to the mammary gland, this structure and the nipple being otherwise left intact. In this way I have successfully removed large unilocular cysts of the size of a shaddock. If the cysts be compound and numerous, the case is more serious, and then their extirpation only is not advisable.

When the disease is truly a *Cystic Sarcoma* it is better either to leave the tumour and treat it by palliatives, or to remove the whole breast; partial removal of the breast, extirpation of the tumour with its lobe of the mammary gland only, is not usually a very successful operation. Recurrence of cystic development will almost certainly occur; and often very severe inflammation of the glands and of the adjacent textures is set up. This I have seen on several occasions, and therefore think it better that the breast should either be left, or removed *in toto*. Such an operation, however, should not be undertaken in the early stages; as the tumour may continue for many years without seriously troubling or endangering the patient, and may perhaps eventually undergo atrophy or absorption. If, however, it show a disposition to increase, to become troublesome by its bulk, or painful, it should then certainly be extirpated; and this operation may always be performed with a good prospect of success, inasmuch as the disease is not malignant, and does not tend to contaminate the constitution. It is a remarkable fact, however, which has been adverted to by Lawrence and Brodie, that, even though the whole of the breast be extirpated, a similar affection occasionally recurs in the cicatrix, requiring subsequent operation; and then, perhaps, being permanently eradicated. This must either be owing to some portion of the cystic structure having been left in

the first operation, or to the development of new cysts in the site of the former; but to which cause it is referable, is still uncertain. The repeated recurrence of these cystic tumours is very remarkable. Cowper has related a case in which the growths had to be removed eight times in many recurrences. After the removal of the cystic sarcoma, a recurrent tumour of cancerous character is sometimes developed in the same site; even in cases in which there is good reason to believe that there has been no carcinomatous element in the primary disease. Yet in other instances it is doubtless owing to the cancerous degeneration of the cystic growth, and may originally have been benign, but in which a malignant action has established itself before removal.

Sanguineous Cysts are occasionally met with in the mamma. They represent the ordinary characters of cystic development, but are sometimes accompanied by bleeding from the nipples, and, when tapped, are found to contain dark thin sanguinous fluid.

VARIOUS RARE TUMOURS.—Besides these tumours, the breast is occasionally the seat of other morbid growths; for instance, fibromata, myxomata, and cartilaginous masses have been met with. All these affections, however, are of extremely rare occurrence; and, when they form, it is almost impossible to determine their true nature until after removal. Their recognition is usually practised on account of the obscurity attending the diagnosis, and the fact of their commonly being mistaken for cancerous growths.

The most important of these, perhaps, is a *Recurrent Fibrous Tumour*, which shows a remarkable tendency to return after removal. This may do many—as often as eight or ten—times.

Sir A. Cooper describes a *Scrophulous Tumour* of the breast; the precise nature of which is not very apparent from the account given by that surgeon. It is not improbable, however, that it is of tuberculous character; and Velpeau states that he has found tubercle occurring in the breast in two forms: in the first, primarily deposited in the skin and subcutaneous cellular tissue; and in the other, as a fibro-tuberculous affection of the gland itself.

Hydatids of the breast are of rare occurrence, and have been principally described by Sir A. Cooper; cases have also been related by Grawitz and others. These hydatid tumours are so excessively rare and obscure, that their true nature would not, in all probability, be suspected until after removal. They present the ordinary characters of deeply seated cysts, with fluctuation and some induration round the globular swelling, and an absence of pain. In such a case, an incision into the tumour will cause the escape of the acanthocysts, and the ultimate suppuration of the cavity in which they lodged, which will gradually cicatrise.

In some rare cases, tumours containing *Fœtal Remains* have been met with in the breast; these, however, are rather matters of pathological curiosity than of practical importance.

MALIGNANT TUMOURS OF THE BREAST.

All the various forms of cancer have been met with in the breast; scirrhus, however, occurs with far greater frequency than any of the other varieties. Occasionally the encaphaloid form of the disease is met with, but it is very rarely occurs. There is, however, a preparation in the University College Museum illustrating the disease, and I have once removed a very large encaphaloid tumour from this region. Cancer of the breast, whatever form it assumes, is invariably primary; it may affect one lobe only, or be infiltrated into the whole gland; and it may commence in the nipple or in the ducts of the

the breast. Most frequently one side only is affected; but in some cases both mammary glands are implicated.

SCIRRHUS.—Scirrhus is the form of cancer which is commonly met with in the breast. It may occur in several ways: either affecting the nipple; implicating the skin, primarily deposited in the form of an intramammary tumour; or infiltrating the whole substance of the organ. It most commonly commences as a circumscribed tumour of small size, at first perhaps smooth and round, hard and indolent in its character, with little or no pain; it is readily movable, may be situated in one lobe, and is attached perhaps to the rest of the gland by a distinct pedicle. As it increases in size, it becomes hard, knobbed, and irregular, perhaps presenting a finely granular feel, and becoming fixed to the gland and adjacent parts. When the disease begins as scirrhous infiltration of the breast, the mass is from the first, hard, rugged, irregular, nodulated, and heavy; often somewhat square in shape, and early accompanied by adhesions to adjacent parts. In other cases, the development of the scirrhous mass is accompanied by a corresponding atrophy of the mammary gland, which becomes shrivelled and disappears entirely. In some instances, rather large cysts may form in connection with the scirrhous mass. In a woman, whose breast I once removed for what was supposed to be cystic sarcoma, but which proved after the operation to be a scirrhous tumour, the mass contained several cysts as large as cherries, filled with dark or greenish fluid, and projecting from its surface; and in a lady under my care for scirrhus of the breast, a tumour as large as a pigeon's egg, containing sanguinolent fluid, formed on the surface of the tumour.

As the swelling increases in size, it has a tendency to be more fixed to the adjacent parts, becoming adherent to the pectoral muscles, and incorporated with the cellular tissue at the border of the axilla. The tumour also begins to form a distinct external projection, and becomes more irregular in shape; it is the seat of severe pain, more particularly at night; and is usually covered by a plexus of blue and dilated veins. The ordinary symptoms of cancerous cachexy now appear, and the disease then makes still more rapid progress.

The tumour may in some cases remain for a great length of time without implicating the skin; but most commonly, after it has existed for a few months, this tissue becomes more or less involved in the morbid action. Instead of being loose and movable over the surface of the cancer, it will be found, on being pinched up between the fingers, to dimple at one part, where it may be felt to be attached by a kind of cord-like process to the tumour beneath it. After a time, that portion of the skin which first became fixed in this way acquires a reddish or purplish colour, and is covered with thin, scaly, epidermic desquamations, and becomes permeated by a number of small ramifying vessels. A crack or fissure eventually forms in this; a small exudation of a mucous fluid takes place, which dries into a scab; under this, ulcerative action sets in, which speedily assumes the ordinary characters of a scirrhous ulcer, having hard, elevated, and everted edges, a greyish-green or foul surface, and discharging a quantity of very fetid pus. In some cases ulceration may take place at several points, and thus the whole surface of the breast become converted into one immense chasm, which may even extend up into the axilla.

The skin, when affected, often assumes a red, glazed, hard, and brawny character, being shining, and as if greasy upon the surface, having its pores enlarged, and enveloping the side of the chest in a kind of stiff solid casing, attended usually by much pain, considerable oedema of the arm, and an

aggravated form of constitutional cachexy : ulcer of this hardened mass, and then speedily destroys it. The cancerous development seems to develop its energy chiefly upon the cutaneous structures. It is small, atrophic, and implicates the nipple. The cancer spreads into the surrounding integument, which is assuming a hard, leathery character, or feeling, but without discoloration, but presenting a hypertrophy being enlarged, and the interspaces between them the infiltrated skin assumes a brownish or purplish rough desquamating crusts, so as to resemble the diseased state of the integuments will extend very far or further development of the tumour situated in this way seen the integuments of the whole first clavicles to below the mamma, and from one axilla to the other, hard, and leathery, of a brownish-red colour, for some time, but without ulceration. This condition is remarkable that in it the axillary glands are not yet rendered cachectic, at nearly so early a stage as the cancer primarily originates in the mammary gland, and in the skin.

Another way in which the skin becomes implicated in the formation of a scirrhus tubercle or nodule is in the internal or axillary border of the mamma. From this the cancer extends inwards, implicating the gland in a secondary and limited extent.

The *Pain* is in many cases but trifling in the early stage, so much so, indeed, that it is the tumour, often first excites alarm ; as it increases, however, the pain becomes more particularly at night, is greatly aggravated by the pressure of the mass, and chiefly extends up to the shoulder and arm. It usually becomes most severe about the time when the cancer usually becomes most severe about the time when but as the cutaneous infiltration goes on, it gradually leads to the destruction of the cutaneous nerves.

Retraction of the Nipple commonly commences when the skin is implicated ; it appears to be owing to the nipple becoming involved in the mass of the tumour, and to the shortening of the lacteal ducts ; in consequence of the nipple being completely buried. This sign has, I think, more value than it deserves in connection with cancer, as it is not of malignant disease, and is occasionally met with in other tumours.

The *Axillary Glands* usually become enlarged, and attain a greater size than that of the original tumour. A kind of indurated cord may be felt external to the absorbents, from the edge of the pectoral muscle to the supraclavicular or subclavicular glands may be felt. In fact, the whole of the glandular structures in the axilla undergo cancerous infiltration. When this is the case, the pressure exercised upon the axillary vein may occasion the swelling of the arm. The glandular infiltration usually increases rapidly, and is implicated. In some cases, scirrhus of the axilla is the primary disease ; and in other instances it happens that

ected, the chief virulence of the disease appears to expend itself upon them. The tumour of the breast ceases to enlarge, or may even atrophy, whilst the secondary glandular deposits in the axilla become greatly developed.

As the scirrhus extends, it may gradually affect the subjacent muscles, cellular tissue, the ribs, and at last the pleura, giving rise eventually to hydrothorax or secondary visceral deposits. In many instances, however, the disease proves fatal by the induction of exhaustion. The constitutional cachexy is in many cases not very distinctly marked, until after the skin has become involved; but then it rapidly increases, more especially when ulceration takes place. Indeed, the cancerous degeneration of the skin may be looked upon as an epoch of peculiar importance in scirrhus of the breast, as it is at this period that the pain increases, that the lymphatic system becomes infected, and that the constitution becomes distinctly poisoned.

Duration.—The duration of life after the occurrence of scirrhus of the breast varies greatly; so much so, that the disease may be considered as assuming an acute and a chronic form. The acute variety principally occurs in ruddy and plethoric women, and commonly proves fatal in a few months. In those who are of a more feeble and delicate constitution, the disease, as a general rule, takes a slower course. Sir A. Cooper states that the disease, on an average, is from two to three years in growing, and from six months to two years in destroying life after being fully formed. In this estimate, which is probably correct, Walshc agrees; so that the average duration of life in cancer of the breast would probably be about three years. As a general rule, the progress of scirrhus is slower in old people, in whom it occasionally gives rise to a kind of atrophy of the breast, with shrinking and induration of the tumour. There are many instances on record, however, in which cancer of the breast has existed for a far longer period than has just been mentioned; for ten, twelve, or even, as in a case related by Sir B. Brodie, for twenty-five years.

Pathological Structure.—After removal, scirrhus of the mamma presents considerable variety in appearance. In the majority of instances it occurs as a peculiarly hard, knobbed, and irregular mass, creaking under the knife when cut, and presenting on section a greyish or bluish grey, semi-transparent surface, traversed in various directions by bands of a more opaque character, and exuding on pressure a thin reddish juice. In many instances, masses of an opaque appearance and yellowish tint may be seen in the midst of the tumour. These, which look like tuberculous deposits, consist in reality of fatty degeneration of the scirrhous structure. In other cases again, on pressing the tumour, small drops of a thick creamy fluid will appear to exude at various points. This appears to be the inspissated and altered secretion of the gland retained in the ducts. Cysts are occasionally, though rarely, met with in scirrhus of the breast; these are usually small, and contain clear fluid, being deeply imbedded in the substance of the tumour; in other cases they may be large and globular, and filled with a bloody or dark-green liquid. The microscopical characters of scirrhus of the breast are such as are represented in Fig. 165.

ENCEPHALOID.—Encephaloid of the mammary region and gland is by no means of such common occurrence as scirrhus, yet all the varieties of this form of cancer have been met with in the breast; and fungus hæmatodes has been seen to spring from the bottom of cystoid growths previously developed in this region. Encephaloid of the breast may sometimes acquire a considerable size; thus, Cruveilhier relates a case in which the tumour

weighed nearly twelve pounds. The structure of from that of the same affection in other situations soft varieties may be met with, and in some advanced growths occur.

Encephaloid usually begins deeply in the substance sometimes, but more rarely, at a little distance globular tumour, which rapidly increases in bulk it are not at first adherent, but are usually pushed become permeated by a largely ramified network have seen the integuments, early in the disease, as to mask the subjacent tumour. The mass at several soft and rounded tumours, which communicating sensation, perhaps causing the surgeon to cystic formation or an abscess; with which it is founded in those cases (rare, it is true) in which cedematous. The breast now rapidly assumes a form; the skin covering it at its most projecting reddened, and at last gives way, leaving a large fungous mass of greyish or reddish-brown colour good deal of discharge of a foul, bloody, and often disintegrated masses are occasionally detached by and cases may even occur in which the whole of the away, and, cicatrization taking place, a tolerable These instances, however, are so rare as scarcely the necessarily fatal character of the affection. In structures in the vicinity of the tumour, following occurs in this as in true scirrhus of the breast. It always extremely rapid, particularly in young and

Colloid of the breast is of rare occurrence, and associated with scirrhus or encephaloid. It is and, slowly growing, may attain a very large size of the breast of a lady a colloid tumour which, she had attained a weight of six pounds. Its colour after careful examination by Dr. Harley. In smooth, somewhat lobed, but not adherent to the On section after removal, it was found to be of varying shades, and composed of a dense, smooth loculi and sacs filled with glairy, transparent colloid

CAUSES OF CANCER OF THE BREAST.—These obscure character.

Sex is certainly the circumstance that has the the occurrence of mammary cancer, the disease almost entirely confined to women; yet instances met with in the male breast occasionally occur. In the female may possibly be owing to the great and functional activity of the breast in women. In this organ at puberty and during pregnancy, the it undergoes, the inflammatory affections to which it is exposed, the frequent irritation to which it is exposed uterine derangement, and the diminution in its place at the change of life, are sufficient to explain organ to disease generally; and may not improve reason why it is so peculiarly the seat of cancer.

Age.—The age at which cancer of the breast

between the thirtieth and fiftieth years. According to Birkett, it is most commonly met with between the ages of forty-five and fifty—a period of life that is popularly looked upon as specially obnoxious to this malady. At these ages, cancer of the breast usually affects the form of scirrhus. When it occurs, as it very rarely does, in early life, it more frequently assumes the encephaloid character. I have, however, removed a scirrhus breast from an unmarried woman of twenty-three years of age. In elderly women also, scirrhus is the prevalent form; though I have seen several instances of encephaloid at an advanced period of life, one case in a woman upwards of seventy years of age. Indeed, cancer in either form may affect this organ up to the latest periods to which life is prolonged. Married women are said to be more liable than single ones to cancer of the breast; it may, however, fairly be doubted whether they are proportionately so; and it is a common belief, founded, I believe, in some degree on truth, that the disease is most common in those women who have not borne children.

Injuries inflicted upon the breast, such as blows, squeezes, &c., are commonly referred to, and are greatly dreaded by women, as the causes of cancer. That they might be so in constitutions otherwise predisposed to the affection, does not appear improbable; and that they are so in reality in many cases, I have not the least doubt. The number of instances that have fallen under my observation, in which a blow or squeeze of the breast has speedily been followed by the appearance of a cancerous tumour in it, leaves no doubt whatever on my mind of the truth of the popular belief that associates the injury with the disease, in the relation of cause and effect. *Lactal inflammations* are likewise frequently supposed to tend to the production of cancer of the breast. Of this doctrine I think that we do not possess at present sufficient proof; though it appears highly probable that disturbances of the functions of the organ during lactation may predispose to the occurrence of this disease.

DIAGNOSIS.—The diagnosis of cancer of the breast from other diseases affecting this organ is of the first importance, and is attended by corresponding difficulties. The great point is to determine whether the tumour of the breast is of a cancerous character or not; that the surgeon should go beyond this, matters little in practice—and, indeed, except in some of the forms of cystic disease of this organ, few practitioners would feel disposed to endeavour to carry their diagnosis beyond this point. The great and essential difficulty in determining the nature of a tumour of the breast consists in the fact of the same signs being more or less common to many growths in this region; a hard, circumscribed, indolent mass, chronic in its progress, with a certain amount of pain, being the usual characteristics presented by all solid mammary tumours; and though in nine cases out of ten a tumour presenting these characters, which has existed for a year or more in an elderly woman, and has resisted ordinary absorbent and alterative treatment, is scirrhus, yet instances of the reverse occasionally occur. Nothing can better exemplify the difficulty of diagnosis in tumours of the breast, than the circumstance, which is not unfrequently witnessed, that after the removal of the diseased mass, its section, and careful examination, surgeons of equal experience will differ as to whether it is malignant or not, and to what class of affections it should be referred; and, indeed, in many of these cases it is impossible to ascertain its precise nature without having recourse to microscopical observation.

It is extremely difficult to lay down any definite rules of diagnosis by which the question as to the malignancy of a tumour of the breast can be solved. In the majority of cases of *cystic growth* in this region, there is little difficulty; the existence of cysts of sufficient size to be readily felt or seen

through the skin being generally characteristic of the non-malignant cystic growths. It must be borne in mind, however, that cases, such as one which allusion has already been made, may occur, in which cysts are combined with cancerous development.

The diagnosis between *cystic sarcoma* and some forms of *cystic cancer* of the breast is not always easy; indeed, it may be impracticable, and only determinable after removal by microscopical examination. I have had in the hospital a patient fifty-nine years of age, in whose breast a hard tumour as large as half an orange, had existed for five years; it was perfectly and freely movable, unconnected in any way with the skin; there was no retraction of the nipple, and no lancinating pain. On its upper side, several large cysts could be felt, and seen through the skin. On examination after removal, it was found to be encysted scirrhus, with large cysts of the size of cherries, containing bloody and yellow fluid. The only very suspicious circumstances here were the age of the patient, and the existence of one small indurated gland in the axilla.

In these cases of doubt, the safer plan is always to make an exploratory puncture, and, if necessary, to examine under the microscope the contents withdrawn by the groove in the needle or by the trochar; indeed, if there be the slightest doubt as to the nature of the tumour, this exploratory puncture should never be omitted before its removal is determined upon. I have more than once seen tumours which had been positively pronounced to be scirrhus, and for which amputation of the breast had been recommended, prove to be cystic, and disappear entirely when their contents were withdrawn.

Between cancer and the ordinary *solid tumours* of the breast the diagnosis is often extremely difficult; but we may arrange the chief signs of the two forms of disease in distinct groups, when, by comparing them together, the differences may be more clearly seen.

NON-MALIGNANT TUMOURS.	SCIRRHUS TUMOURS.
<i>Feel.</i> Moderately hard, nodulated, irregular in shape; occasionally more or less lobed; not very distinctly circumscribed; sometimes elastic in parts.	<i>Feel.</i> Of stony hardness, knobby and distinctly circumscribed, or somewhat square, and occupying the whole of the substance of the gland.
<i>Mobility.</i> Considerable, though occasionally there is a deep pedunculated attachment.	<i>Mobility.</i> At first considerable, but soon becomes fixed to the deeper structures by a broad attachment.
<i>Skin.</i> Of the natural colour throughout, though thinned and expanded, with the tumour lying close beneath it. Only implicated in the advanced stage of cystic sarcoma.	<i>Skin.</i> Early implicated--at first dimpled, then red or purple, and in other cases brown and leather-like, so that it does not admit of being pinched up into folds; or nodulated, purplish red masses form in it.
<i>Nipple.</i> Usually not retracted.	<i>Nipple.</i> Usually retracted.
<i>Veins of the Skin.</i> Not much dilated.	<i>Veins of the Skin.</i> Very greatly dilated.
<i>Pain.</i> Often moderate, if severe, continuous or of a neuralgic character, much increased by handling.	<i>Pain.</i> Severe and lancinating, especially at night after handling, and when the skin is implicated, but not continuous.
<i>Axillary Glands.</i> Of usual size, or but slightly enlarged and movable. Lymphatics not affected; supraclavicular glands not affected.	<i>Axillary Glands.</i> Enlarged, indurated, and fixed. Indurated mass of lymphatics under and parallel to edge of the axilla, stretching into the axilla; supraclavicular glands enlarged.
<i>Constitutional Infection.</i> None.	<i>Constitutional Cachexy.</i> As disease advances.

Rapidity of growth, although always a very suspicious circumstance, cannot by itself and without other signs be taken as unequivocal evidence of malignancy of action. I have seen a chronic mammary tumour increase from the size of a hen's egg to that of the adult head in less than six months, and after removal not present the slightest evidence of malignant disease, on the most careful examination.

Recurrence after removal, though a very suspicious circumstance, is by no means a proof of malignancy. Rapidly growing adenocoele will recur. This I have seen happen three times in a lady, otherwise in perfect health, and without a trace of malignant disease in the system or in the tumour. So also the recurring fibroid tumour has been removed eight or ten times from the breast, before its complete extirpation has been effected.

TREATMENT.—In cases of cancer of the breast, the first question that presents itself to the surgeon is, whether any plan of treatment short of the removal of the tumour holds out a prospect of cure, or even of relief; and if not, whether the extirpation of the cancerous breast can be undertaken with a prospect of ridding the patient of an otherwise fatal disease, or at least of prolonging her existence. To these questions the remarks made at pp. 490 *et seq.*, on the general treatment of cancer, may be considered applicable. The management of cancer of the breast, however, involves so many special considerations of importance, that it becomes necessary to consider its bearings somewhat in detail.

No constitutional means appear to be of the slightest service in arresting, and still less in removing, cancerous tumours of the breast. The advantages stated to have been derived from the use of arsenic, conium, iron, and various preparations of mercury, have not been borne out by experience; and, indeed, it may be stated generally that these and all other known remedies are perfectly valueless in the curative treatment of this disease.

Compression by various means, whether by plasters, as employed by Young; by agarie, as used by Recamier; by the sprung pads of Tanchou; or by the slack air-cushion of Dr. Arnott, has been much praised, not only as a palliative, but as a curative means of treatment in this disease; and cases are recorded, which, however, even the warmest advocates of this plan of treatment are forced to admit to be altogether exceptional, in which the employment of this means has been stated to have effected a complete removal of the tumour. But, although I am not prepared to deny that hard and chronic tumours of the breast may have become absorbed during the employment of this treatment (and indeed I have had occasion to observe this in my own practice, in cases of chronic mammary growth), I think that evidence is altogether wanting to show that an undoubted case of cancer of the breast has ever been cured by this means. And, notwithstanding the high authority with which some of these alleged cases of cancer have been brought before the profession, no positive proof has been adduced to show that the tumour that was observed was really and truly of a cancerous character, and that it may not have been either a chronic mammary tumour, or an encysted abscess of the breast. Every practical surgeon well knows that it is utterly impossible, in the present state of science, to diagnose in many cases with complete certainty the true nature of a tumour of the breast, and must frequently have witnessed cases in which, after extirpation, the morbid growth has been found to be of a different character from what had originally been supposed. I am acquainted with at least eight or ten cases in which some of the most experienced surgeons, both in this country and in Paris, have amputated the breast for supposed scirrhus; when, after removal, it was found simply to have been the seat of a chronic abscess with very dense walls. And with

regard to a hard, chronic, and indolent tumor, will hazard a positive diagnosis as to its nature, until they have actually seen a section of that men of equal experience will differ as to its nature. For these reasons, in the utmost hesitation the cases of suppuration cured by the advocates of compression recorded by these gentlemen as instances of this plan of treatment may have been other than those of a cancerous character.

But, though there is no evidence before me of compression as a curative agent in cancer when practised with Dr. Arnott's slack air, it is of considerable value as a palliative in this disease; when it may undoubtedly at a time, diminish the size of the swelling, attacks of lancinating pain which are so connected with the pressure, much relief to the use of belladonna plasters, or of atropine with the internal exhibition of conium. In some cases, however, when the skin is involved, increasing the pain, and acting as a source of some cases of this kind, in which the slack air I have seen relief afforded by moderate pressure supported by an elastic bandage, belladonna dusted on the innermost layer of amadou, moulded to the part, may sometimes be used, and kept on by turns of an elastic roller. In very tender, the application of bread poultice and lead lotion is of use. When the disease is advanced, internal administration of conium, so as to produce local application of chlorinated lotions to the application of the watery extract of conium much use. In cases of this kind, the tumor, greatly vaunted, and portions of the disease removed by these means.

Caustics, applied in accordance with the plan, may occasionally be advantageously employed on the breast, when excision is not practicable, and the patient positively refuses to submit to the operation, so that the effects of loss of blood, and cancer is already ulcerated.

OPERATION.—The constitutional and local effects of the breast being thus, at the most, of a palliative operation always presents itself at last. The first operation are, in the first place, by the external application prevent constitutional infection, and thus save from her necessarily fatal affection; or, failing of the constitutional infection, and thus attain far these objects are attained by amputation. The subject of important inquiry to the surgeon, is discountenanced by many excellent pathologists, on the intrinsic danger it may possess, for, although syphilis or some similar accidental complication

hazardous about it ; nor from its being now, as formerly, open to the objection of subjecting the patient to unnecessary pain, all suffering during its performance being prevented by anaesthetics, and little inconvenience being experienced at subsequent dressings, which are usually of a nearly painless character ; but the great objection lies in the fact of the disease, in many cases, returning and running its course as rapidly after the operation as if none had been performed, and in others perhaps even more rapidly.

The principal points in connection with the operation appear to resolve themselves into two questions :—1. In any case of cancer of the breast, may constitutional infection be prevented by amputation of that organ ; and, if so, under what circumstances will this most probably happen ? 2. Although the disease may eventually return in the part or elsewhere, may not excision arrest the rapidity of the fatal termination ? (*Vide p. 496.*)

1. In answer to the first question, it is not easy to give a very definite reply. Nothing shows more clearly the utter worthlessness of many so-called surgical statistics, than the discrepancy that exists between those which have been published as exhibiting the liability to relapse of cancer after operation. Thus, Hill states that, out of 88 cancers on which he had operated, at least two years before the return was made, there were only 10 relapses, and 2 deaths ; whilst Alexander Monro states that, out of 60 cancers which he had seen removed, in only 4 patients was there no relapse at the end of the second year. Boyer saved 1 only in 25, and Macfarlane gives a still more unfavourable account of his practice ; for he says that, out of 32 cases of cancer operated upon by himself, there was not one instance of radical cure ; and of 80 other cases with which he was acquainted, the result was in every instance unfavourable. Warren, on the other hand, saved 1 in 3 ; and Cooper 1 in 4. Amidst such conflicting statements as these, it is clearly impossible to eliminate more than the general fact, which is well known to every surgeon ; that, in a large number of the cases of cancer operated upon, there is a tolerably speedy return of the disease. In these cases there are, however, many points to be taken into account, of which gross statistics can take no cognisance ; much being necessarily dependent upon the skill with which the operation is performed, as well as upon the care employed by the surgeon to cut widely of the disease, and to extirpate completely not only the whole of the morbid mass, but those tissues in its neighbourhood which might be supposed to be implicated.

In many of these cases, also, it is by no means improbable that the practice, at one time pretty generally followed, may have been adopted, of merely extirpating the tumour without removing the whole of the breast. I am therefore disposed to look upon any deductions based upon the statistics of such men as Hill, Macfarlane, and Benedict, as of very little value when applied to the surgery of the present day.

It would, however, appear from those inquiries, that in a certain proportion of cases, whatever the precise ratio be (and this is still undetermined), the disease may be effectually removed by extirpation of the breast.

2. As to the second question, whether as a general rule life may not be prolonged by the performance of the operation,—it would appear, if the statistics collected by Leroy D'Etiolles are accurate, that hitherto it has not been so. Dr. Walshé comes to the conclusion that the operation cannot, as a general rule, be regarded as a means of prolonging life, but that in the majority of cases, death is hastened by such interference. Sir A. Cooper and Sir B. Brodie both agree that, in most cases, the disease returns in two or three years after the operation, and then kills the patient.

But though the general result of a statistical inquiry into this subject,

based upon the imperfect materials and probably present before the profession, leads to the conclusion that cancer of the breast, when indiscriminately performed, failed to cure the disease, but has actually in many cases hastened its fatal termination, yet it must be admitted that it does occur in which life is certainly prolonged beyond its average duration in this disease. The case in which no return took place for twenty years that he has removed encephaloid tumours of the breast has remained free from the disease for eight or ten years, and other surgeons relate similar instances in which life has been prolonged after the performance of the operation. The opinion of the most eminent practical surgeons is decidedly in favour of recourse to it under certain circumstances.

The only reliable statistics that we possess on the subject are those collected by Paget and Sibley. Paget states that of 121 cases submitted to operation; of these the average duration of life was 64 months. Of 64 operated on, the corresponding average duration of life was 11 months. In the first two years of the disease the duration of life was much less in those operated on than in those not operated on; the former less than 11 per cent., in the latter more than 11 per cent. The longest duration of life in cases not operated on, a little more than 12 years. The average duration of life in unoperated cases was 18 months. In those subjected to amputation of the breast it was 11 months.

There is, however, another point of view from which the question may be considered; for, even if they do not positively improve the patient's condition, and place her in a more comfortable position during the remainder of her existence, they do remove so much pain from the local affection, or, if the patient is much affected by the fetor of the discharges, they afford a position of far greater comfort by having the irritation removed; and though she die eventually, she is much less suffering to herself and others from the secondary deposits in the lungs or liver, than to be afflicted with the local affection.

In considering the propriety of operating in cancer of the breast, the utmost importance to distinguish those cases in which it possibly be the means of preserving or prolonging life, and those in which there is no prospect of its being of any service, but which inevitably hasten the patient's death. Whatever the result be in determining the question, whether in cancer of the breast generally the operation will effect a cure or prolong life, is of less value in their application to individual cases. For his opinion respecting the propriety of amputating the breast of a patient before him, it is not sufficient for him to know the general result of the operation may be, but he must know whether the particular instance under consideration is a favourable case, exceptional perhaps, in which there is a fair prospect of the disease entirely from the system, or at all events of its long existence. In order to do this, it is necessary to establish some rules that may guide us in selecting those cases in which it may be advantageously done, and in setting aside

that it will almost to a certainty hasten the patient's death. And, indeed, the absence of all such considerations in general statistical investigations into the results of operation for cancer, that deprives them of much of their value as guides in actual practice.

Though nothing can be more unsurgical or improper than the indiscriminate extirpation of all cancerous tumours of the breast from every patient who may present herself in whatever stage of the disease; and though such a practice would doubtless be followed by fully as disastrous results as those that occurred to Macfarlane, Benedict, and others; yet there can be little doubt that a surgeon who would employ a certain principle of selection, could obtain a very different and a far more successful result in his practice. Sir B. Brodie has very clearly and succinctly pointed out the most important circumstances by which the question as to the propriety of operating in these cases should be determined. Before doing so, he very justly dwells on the fact that in many cases the operation may fail, and the disease speedily recur, through the negligence of the surgeon in leaving behind portions of the gland, slices of the tumour, or contaminated tissues, and that thus the operation may receive discredit for what is in reality the fault of the surgeon who has performed it.

With reference to operations, cancerous diseases of the breast may be divided into three classes:—1. Those in which it is the duty of the surgeon to discountenance excision; 2. Those in which operation is of doubtful expediency; and 3. Those in which it is the duty of the surgeon to recommend it.

1. *Cases unfit for Operation.*—In this class we may include the following conditions: *a.* Those cases in which there is strongly marked constitutional cachexy; *b.* When both breasts are involved; *c.* When there are secondary deposits in internal organs; *d.* When the glands under, and especially above, the clavicle are much enlarged; *e.* If the tumour be adherent to the ribs and intercostal muscles; *f.* When the skin is hard, brawny, and infiltrated, of a reddish-brown colour, having a hard, leathery feel, or a greasy, glazed appearance; *g.* If the tumour be rapidly growing in a patient with a strong hereditary taint; *h.* If it be extensively ulcerated and fungating.

2. *Doubtful Cases.*—*a.* If the patient be aged, weak, or anæmic, and the tumour large, it is seldom expedient to operate, as the shock may destroy life. *b.* When the skin is merely dimpled in by a kind of pedicle passing from the tumour to its under surface, an operation may be performed, unless other circumstances should contraindicate it; but in such cases it is necessary widely to excise the integument surrounding the attached point. The cancer-cells, as I have more than once had occasion to observe, will be found to have diffused themselves extensively through the neighbouring skin, which, to the naked eye and to the touch, has a perfectly healthy appearance, the tumour being surrounded by a kind of halo or atmosphere of cancer infiltration. *c.* When there is but moderate enlargement of the axillary glands, which are so situated as to admit of removal, the operation may be performed. *d.* When the cancer is ulcerated, it is seldom proper to operate; but if all other conditions be favourable, this even need not in some special cases be a bar. As Sir B. Brodie has pointed out, the patient's existence may sometimes be prolonged, and her comfort materially increased, by removing the diseased and ulcerated mass.

3. *Cases favourable for Operation.*—The exclusion of all the cases that fall under the preceding categories will necessarily limit very materially those in which an operation may be undertaken; it can, however, be performed

with every prospect of its being advantageous to the patient, if the tumour be of moderate size, slow or nearly stationary in its growth, unconnected with or at least merely attached by a pedicle to the skin, pretty distinctly circumscribed, movable on the subjacent parts, and not complicated with enlarged glands in the axilla or elsewhere. The patient has an especial good prospect of recovery, according to Brodie, if the disease be seated in the nipple.

When once a tumour of the breast has been ascertained to be of cancerous character, the sooner it is removed the better, unless one of the special reasons adverse to operation that have just been adverted to should exist. I cannot conceive that any good can come of delay in these cases. The disease (for reasons stated at pp. 488-489) appears in the early stages often to be entirely local; there is no evidence of constitutional infection, but if the operation be delayed the skin speedily becomes implicated, the axillary glands enlarge, and cancerous cachexy sets in. As a general rule, it may be stated that in all cases of cancer of the breast the whole of that organ ought to be freely removed, especial care being taken that no slices of mammary structure be left behind; and after removal the under surface and edges of the gland ought to be carefully examined, with the view of seeing that the extirpation has been complete. When the cancer is infiltrated, the whole of the breast and the surrounding cellulo-adipose structures must be very freely removed, as there is often a halo of cancer-deposit around the morbid mass, in tissues apparently healthy. It may happen that the tumour, especially if scirrhus, is apparently isolated, and situated at the outer border of the gland, scarcely, if at all, connected with that structure. Here the question will arise, as to whether the whole of the organ ought to be removed or not. In determining this we must, I think, be guided by the position of the scirrhus mass and the size of the breast. If it be situated towards the sternal or under aspect, however isolated it may appear, it will be found that the mammary gland will probably have become infiltrated more or less, lying as it does between the morbid mass and the lymphatic vessels. When, however, the tumour is seated at the upper or outer border of the gland, when it appears to be detached from the breast, lying rather in the axilla or below the clavicle than in connection with the gland; when the breast itself is very large and fat, but healthy to the feel, without hardness or retraction of the nipple; when there is no sign whatever of deep infiltration of the breast—it may then be a question whether it will not be more prudent to extirpate the tumour alone, with the adipose bed in which it lies, and a deep slice of the adjoining mammary gland, than to perform the more serious operation of removing the whole of the breast. In determining this point we must, I think, be guided by the situation of the tumour, the feel of the breast, and the size of that organ. If the tumour be distinctly axillary, if the breast feel perfectly soft and healthy, with the nipple projecting, and if it be of very large size, the surgeon best consults the patient's safety by simply removing the tumour with a deep slice of the contiguous portion of the gland; but if there be any hardness or suspicious nodulated feel about the mammary gland, if the line of demarcation between it and the tumour be not defined, and particularly if the patient be thin and the breast small, so that the operation is not a very severe one, the extirpation of the whole of the breast ought certainly to be practised. However widely the parts are removed, the line of incision usually comes together readily and evenly, owing to the laxity of the integuments in the mammary region.

I have observed in those cases in which it becomes necessary to extirpate tumours of the mammary region, without removal of the gland, that

myxoid has more frequently followed the operation than when the gland, being affected, has required removal.

Return of Cancer after Operation may take place in three situations; in the cicatrix of the part operated upon; in the neighbouring lymphatic glands; or in some internal organ. When cancer recurs in the neighbourhood of the previously affected part, it is probably owing to the cancer-cells having infused themselves so widely into the skin, the subcutaneous cellular tissue, and muscles, or neighbouring lymphatic glands, that after the removal of the tumour these cells become the germs of new growths. Under these circumstances, it may recur in the cicatrix and then implicate the glands; or in the glands, without the cicatrix having been previously affected. In local relapse of this kind, it often happens that the disease, so reproduced, runs a course more rapidly than if no operation had been performed; the increased action set up in the part during the healing process appearing to give augmented force to the reproductive energy of the cancerous growth. In some cases it even returns in the cicatrix before cicatrization is completed, the ulcerated surface then assuming the ordinary character of the cancerous ulcer. In other cases the cicatrix, some weeks or months after it is fully formed, assumes a dusky red or purplish tinge, becoming hard, stony, and nodulated at points; these nodules being round or oval, often very numerous, and varying in size from a pin's head to a pigeon's egg, studding the whole length and breadth of the cicatrix, and at last running into true cancerous ulceration. Under such circumstances the only hope of prolonging the patient's life lies in the speedy excision of the whole of the diseased structures, or their extirpation by caustics, provided there be no deep affection of the glands, nor evidence of internal secondary deposit. But if the axillary glands be much enlarged, either alone or together, with recurrent disease in the cicatrix, or if there be any sign of internal cancer, further operations will be improper.

AMPUTATION OF THE BREAST.—The operation for the removal of a breast, whether affected with cancer or with other disease, may be performed in the following way. The patient should lie upon a table, with the arm hanging over the side, tied down or held by an assistant. If the tumour be large, and the loss of blood a matter of much consequence, another assistant should compress the subclavian artery on the first rib. The hemorrhage will, however, depend more on the nature than on the size of the tumour. In all cancerous tumours, but especially in the encephaloid, it is considerable, and from many enlarged vessels. In simple tumours, even of very large size, it is often trivial. I have removed a simple tumour of the breast of many pounds weight, and only had to tie one spouting vessel. Indeed, nothing indicates more conclusively the enormous vegetative activity of cancerous tumours, and the great drain they must exercise upon the system generally, than the large size and great number of their supplying arteries, compared with those sent to a simple tumour many times larger than the malignant one. If the veins about the part be much dilated, measures should be taken to arrest the flow of blood from them, as it may sometimes be dangerously profuse; indeed, South relates the case of a patient who died from this cause during the operation.

Some surgeons make a perpendicular, others a transverse incision. I prefer an oblique incision following the course of the fibres of the great pectoral muscle; as it enables the surgeon, if necessary, to extend the cut into the axilla for the removal of enlarged glands, and, after cicatrization, allows of the movements of the arm without undue traction. An oblique elliptical incision, of sufficient length, may thus be made, first below, and next above

the nipple, so as to include a sufficient quantity of skin, where the skin is somewhat involved, made in addition to this, so as to include in a triangular manner. When the tumour is very large, a vertical incision may very conveniently include the suspicious parts of the skin. The dissection is then carried down, by a few strokes of the scalpel, to the cellular bed in which it is situated. If the tumour is of large size, and especially if it be of simple character, the dissection may be done very expeditiously by drawing down the cellular tissue with the scalpel, when the pectoral muscle, and can readily be detached from the diseased breast, it and the tumour, as well as the surrounding tissue, must be carefully examined, in order to see if morbid tissue have been left behind; if so, it must be removed. Should it be found that there are lymphatic glands in the axilla, they may be extirpated either by extending the incision into this region, or by making a separate incision, and dissecting them out. In doing this, the edges of the wound must be very carefully used, and the glands rather taken out with the knife and the fingers, so as to avoid the risk of leaving any behind. The extirpation of the axillary glands is the most troublesome part of operations on the breast, and is much higher into the axilla and under the edge of the tumour than would at first appear. When exposed, they are to be removed with a hook or an artery-forceps, well drawn down, and then cut out with the knife, aided by a few cuts with the fingers. The less the point is used deep in the axilla, the more practicable with the knife; but, having been exposed in the way already mentioned, it is not difficult to remove them, and then tightly tied as high as possible with a ligature, the portion below the noose being then cut off. The two great dangers which attend extirpation of the axillary glands are, deeply situated and out of sight—hemorrhage from the dilated veins; and, the ligature being applied to a vessel which remains of it will slough away when the ligature is removed.

It occasionally happens that tumours are of a primary disease, unconnected with any malignancy, either in the upper extremity or in the breast, of a strumous or of a cancerous character; when strumous, they are readily enough removed, and they become so widely and deeply adherent, that their removal is undertaken without much danger. In such cases, the dissection is to expose the axillary and subscapular vessels, and the tumour is to be removed.

After any bleeding vessels have been ligatured, the breast has been taken out may be brought together by suture, and supported by a bandage, so as to prevent the wound from opening. In many cases it will unite by the yielding nature of the parts in this situation, and form into very good apposition, even though a consid-

By some it has been supposed that relapse of cancer is less liable to take place if the wound unite by granulation, than if it come together by more speedy union ; of this, however, there is at present no proof with which I am acquainted, though it is by no means improbable that the suppurative action may eliminate cancer-cells from the neighbouring tissues.

The *mortality after amputation of the breast* is not considerable, barely amounting to 10 per cent. The circumstances that chiefly influence it are the nature of the tumour, and the extent of the incision into the axilla. It is much greater after operations for cancerous than for simple tumours ; and the operation becomes dangerous in proportion as the dissection requires to be carried deeply into the axilla or under the pectoral. The danger here is threefold : 1, from hemorrhage ; 2, from the entry of air into a vein ; 3, and chiefly, from opening up the deep fascia of the axilla, and the risk of the occurrence of deep cellulitis. When death follows these operations, it is usually the result of erysipelas or of pyemia.

DISEASES OF THE BREAST AND AXILLARY GLANDS IN THE MALE.

The *male breast*, though very rarely the seat of disease, may occasionally become affected in a somewhat similar manner to the mammary gland in the female ; being, in some instances, *hypertrophied*, in others the seat of an *abnormal secretion of milk*, and, in other cases, affected by the formation of *cystic, sarcomatous, and scirrhus tumours*. These growths require removal by the same kind of operative procedure that is adopted when they affect the female breast, though of a less extensive character.

SCIRRHUS TUMOURS may form in men as well as in women, as primary



Fig 380 - Scirrhus Tumour in Axilla of a Male

disease, under the pectoral muscle or in the axilla. (Fig.380). Such tumours might, in their early stages, be dissected out ; but if they extend high up to

the clavicle, or implicate the skin widely by the
be left, as was necessary in the patient from
where the size of the tumour and its connection
of operation. Their removal cannot, indeed



Fig. 381.—Cancerous Tumour in the

without much danger. In dissections requiring
masses, as in Fig. 380, I have had to expose
vessels and their accompanying nerves. The
somewhat widely disseminated, it is difficult
fairly extirpated: hence, recurrence is likely

CHRONIC STRUMOUS DISEASE of the axilla
with, forming a large lobed mass under the p
as this may easily and safely be enucleate
it have resisted all ordinary topical and const
found to be infiltrated with tubercle.

DISEASES OF THE ABDOMEN.

CHAPTER LXI.

HERNIA.

By *Hernia*, in its widest sense, is meant the displacement of any organ from the cavity in which it is naturally contained, by being protruded through an abnormal or accidental opening in its walls; when, however, it escapes through one of the natural outlets of the part, it is not considered hernial. Thus, the protrusion of the brain through an aperture in the cranium, or of the lung through one in the thoracic walls, or of a portion of intestine through the abdominal parietes, is termed a hernia of these organs; but the descent of the bowel through the anus does not come under this designation. Here, however, we have only to consider the hernial protrusions that occur from the abdomen—the common situation of this disease.

A hernia may occur at almost any part of the abdominal wall; though it is far more liable to do so in some situations than in others, being commonly met with at those points where the muscular and tendinous structures are weakened to allow the passage of the spermatic cord in the male, and of the round ligament in the female; or for the transmission of the large vessels to the lower extremity; hence the inguinal and crural canals are the common situations of this disease. It may, however, occur in various other situations, as at the umbilicus, the thyroid foramen, the sciatic notch, in the vagina, the perineum, through the muscular portions of the abdominal wall, the diaphragm, &c.

STRUCTURE OF A HERNIA.—In whatever situation it occurs, a hernia is composed of a *Sac* and its *Contents*.

The *Sac* is the prolongation of that portion of the peritoneum which overlies and corresponds to the aperture through which the hernia protrudes. It is in all cases composed of a *neck* and a *body*.

The *Neck* is usually narrowed, though in some old herniæ it becomes wide and expanded; it is commonly short, consisting indeed of a sudden constriction of the sac in this situation, as happens in many forms of femoral hernia; but in other cases it is elongated, narrowed, and thickened, and even vascular in structure. The neck of the hernial sac usually becomes greatly thickened and of an opaque colour, by the deposit of plastic matter in or upon it from the irritation to which it has been subjected by the pressure of the hernial tumour or the truss, by the incorporation of the subserous cellular tissue lying externally to it, or by the puckering together of its folds, which have been compressed by the aperture in which it lies.

The *Body* of the sac varies greatly in shape, being usually globular or pyriform, sometimes elongated and cylindrical; it may vary from the size of a cherry to a tumour as large as the head. When recent, it is usually thin and transparent, though in some cases it becomes greatly thickened, having arborescent vessels ramifying in it, and being almost laminated in structure; this is especially the case in old femoral herniæ. In other instances, however, it becomes thinned and atrophied as the tumour expands, so that

the contents become visible through it. This umbilical hernia, in which I have seen it as the skin. In some cases the hernial sac undergoes and is converted into a fibrous or even calcareous layer.

The sac, though usually forming a perfect tent, occasionally constitutes but a partial partition, particularly in such organs as the cæcum or sigmoid, which is partially uncovered by peritoneum. In other cases it is altogether absent; more rarely a double hernia is protruded into or placed behind the other. Double sacs occurring together; and Sir A. Cooper has met with in the same person.

The abdominal parietes outside the sac and the aperture through which the hernia protrudes, at a time, indurated and rounded at the edge, and situated in the moveable portions of the abdominal region, it becomes displaced in old hernia by the weight of the protrusion, usually towards the upper part. The cellular tissues always become greatly thickened so as to constitute one of the densest investments of the body. In old cases of hernia, closely to resemble other structures, such as the integument and fascia, stretched; often tense, but not unfrequently usually thinned, but, if a truss have been long used, and condensed by the pressure of the pad.

Contents.—The contents of the sac vary greatly. The pancreas having been found in hernial tumors of the Small Intestine, more particularly of the cæcum, constituting the form of hernia called *Enterocæle*. The diameter of the sac may vary from a small section of the intestine to a coil several times the diameter of the mesentery. After a portion of the intestine has protruded, the part tends to increase in quantity; until, as the greater portion has been known to lie in the sac, it is rarely found in a hernia, though the case is not infrequently met with. When intestine has been long protruded, it is covered by its coats, and narrowed, greyish on the surface, and loses its functions. The corresponding mesentery is atrophied, and vascular.

Omentum is often found in hernial sacs, but not unfrequently met with alone, constituting a separate form of hernia. After having been protruded for some time it becomes indurated and laminated, losing its ordinary cellulo-fibrous structure. Its veins usually assume a somnolent state. The mass of omentum acquires a triangular shape at the abdominal aperture, and the base being fixed to the parietes. In some cases it can be unfolded; in others, it is a conical mass. Occasionally apertures form in the omentum, through which intestine may protrude, thus becoming second sacs. In other instances, cysts are met with in the omentum, in which the intestine may even slip. When intestine is found in a hernia, the disease is termed *enterocele*. In these circumstances the omentum usually does not envelope the intestine. Besides these, the

Stomach, liver, spleen, and all parts of the intestines, bladder, uterus, and ovaries, have all been found in them.

Adhesions commonly form within the sac in old standing cases. These may take place between the contained viscera merely, as between two coils of intestine, or between these and the omentum, or they may form between the wall of the sac and its contents, either by broad bands, or else by bridging across from one side to the other, and in losing a portion of the viscera. In recent cases these adhesions are soft, and may readily be broken down; but when of longer duration, they are often very dense, and are especially firm about the neck of the sac.

Besides the viscera, the hernial sac always contains a certain quantity of fluid, secreted by and lubricating its interior. In most cases, this is in but small quantity; but in some instances, when the sac is inflamed, or the hernia strangulated, a very considerable bulk of liquid has been met with; I have seen as much as a pint escape from a large hernia in an old man. When abundant, it is generally of a brownish colour, though clear and transparent; it is met with in largest quantities in inguinal hernia.

Hydrocele of the Hernial Sac.—In some instances, the fluid becomes collected in a kind of cyst within the sac, formed by the omentum contracting adhesions to its upper part, and leaving space below for the fluid to collect, in which this accumulates between the omentum above and the wall of the sac below; this condition, represented in the following drawing (Fig. 382), has been called *Hydrocele of the Hernial Sac*, and constitutes a somewhat rare form of disease. The fluid is often in considerable quantity; in a case which I tapped some years ago, nearly three pints of dark brown liquid had thus accumulated, and were drawn off.

If we limit the term *hydrocele of the hernial sac* to those cases in which there is a slow and gradual accumulation of fluid at the bottom of an old hernial sac, which has been cut off from all communication with the peritoneum either by the radical cure of the hernia, or by the adhesion of intestine or omentum to the upper part and neck of the sac, it must be considered a disease of unfrequent occurrence; and but few cases are recorded by surgical writers. Curling, in his work on the *Pestis*, states that, during his connection with the London Hospital, he has seen only one case; and the only others with which I am acquainted, besides one that occurred in my own practice, are two related by Pott, two by Poilletan, one by Hoyer, and one by Lawrence. This disease must not be confounded with the accumulation of fluid, in whatever quantity, in strangulated hernia or in hernial sacs that communicate with the peritoneal cavity. Its distinguishing feature is the accumulation of fluid in a sac that has been cut off from all communication with the cavity of the peritoneum.

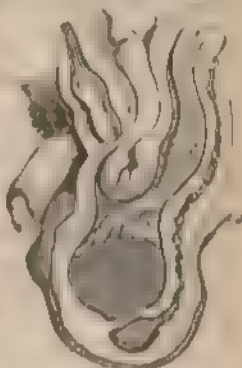


Fig. 382. Hydrocele of Hernial Sac.

Loose foreign bodies have occasionally been met with inside hernial sacs. They are usually rounded, smooth, and firm; vary in size from a pea to a chestnut; and are mostly single. On section they are found to consist of a fatty central nucleus with a laminated fibrous envelope, usually of considerable thickness. They are apparently composed of one of the glandular epiploicae, which has become detached, fallen loose into the peritoneal cavity, and become enveloped in plastic layers.

SIGNS.—The signs of hernia, though varying considerably according to the contents of the sac and the condition in which it is placed, present in all cases many points in common. There is an elongated or rounded tumour at one of the usual abdominal apertures, broader below than above, where it is often narrowed into a kind of neck; usually increasing in size when the patient stands, holds his breath, coughs, or makes much muscular exertion. It can be pushed back into the abdomen on pressure, or goes back readily if the patient lie down, but reappears when he stands up. On coughing, a strong and distinct impulse may be felt in it.

When the hernia is altogether *Intestinal*, it is usually smooth, gurgling when pressed upon, sometimes tympanitic and rumbling, and resonant on percussion. It may be returned into the cavity of the abdomen with a distinct slip and gurgle; it has a well-marked impulse on coughing, and is usually accompanied by various dyspeptic symptoms, and often with a good deal of dragging uneasiness.

Omental Hernia is usually soft and doughy, returning slowly on pressure into the abdomen, feeling irregular on the surface, and having an ill-defined outline. It occurs most frequently on the left side, and is rare in infants, in whom the omentum is short. In *Entero-cynplocle* there is a combination of the two conditions and their signs; but these are usually so uncertain, that few surgeons care to predict before opening the sac what the probable nature of the contents may be.

Cæcal Hernia necessarily occurs on the right side only. It is a large, knobby, and irregular tumour, irreducible, owing to the adhesions contracted by that portion of cæcum which is uncovered by peritoneum. The peculiarity of this hernia consists in the sac being absent, or only partial in the majority of cases, the peritoneum being stripped off as the gut descends. When this hernia is large, and partially invested by serous membrane, a sac usually exists at its upper aspect, into which a portion of small intestine may fall, and which may in some cases constitute a second hernia lying above or before the cæcal one, which will be found situated at the posterior wall when this hernial pouch is opened. Occasionally the vermiform appendix and the caput coli are found in the sac, but can rarely be returned. The rule of cæcal hernia having a partial peritoneal investment only, does not hold good in all cases; and instances have occasionally been met with in which this portion of intestine lay in a distinct sac.

Hernia of the Bladder or *Cystocèle* is of very rare occurrence; and, like that of the cæcum, is usually enclosed in a partial peritoneal investment, though it is not necessarily so. South states that there is a preparation at St. Thomas's Hospital, in which the fundus of the bladder, with its peritoneal covering, has passed into a distinct sac. In some instances the cystocèle is accompanied by an enterocèle. This hernia is always irreducible, is attended by a good deal of difficulty in urinating, with varying tension, according to the quantity of fluid contained; by squeezing it urine may be forced out through the urethra, and fluctuation has been felt in it. Urinary calculi have been formed in the tumour, and have been removed by incision through the scrotum, or have ulcerated out.

CAUSES.—The causes of hernia are usually sufficiently well marked. In some instances, the disease is *congenital*, arising from preteratural patency of the abdominal apertures; in other cases, it occurs at a later period of life, in consequence of some *forcible effort*, as lifting a heavy weight, jumping, coughing, straining at stool, or passing urine through a tight stricture. It is especially apt to occur from such causes as these in tall and delicate people, more particularly in those who have a natural disposition to weak-

ness, or bulging of the groin. The displacement of the abdominal viscera by a gravid uterus, will also occasionally give rise to the disease. Hernia is especially apt to occur from a combination of causes: thus, if an aged person, one with a feeble organisation, or whose abdominal apertures have been patent in consequence of rather sudden emaciation, make a violent effort, a hernial protrusion is very apt to occur.

Amongst the most frequent *Predisposing Causes* of hernia, are certainly sex, age, and occupation.

Sex.—Men are far more liable to this disease than women. Thus, according to Malgaigne, in France, one man in thirteen and one woman in fifty-two are the subjects of hernia. But, though men are more generally liable to hernia than women, they are less so to certain forms of the disease, especially to the femoral and umbilical. It is to the inguinal that they are particularly subject, although old women very commonly suffer from this form. According to Lawrence, out of 83,584 patients who applied to the City of London Truss Society, 67,798 were males, and 15,786 females. For the interesting statistical account of the relative frequency of the different kinds of rupture, deduced from the foregoing figures, I would refer to Lawrence's most excellent *Treatise on Hernia*, 5th ed. p. 11.

Age exercises a very material influence upon the frequency of hernia. Malgaigne, who has carefully investigated this subject, finds that in infancy the disease is sufficiently common, owing to the prevalence of congenital hernia at this period of life; and, that in the first year after birth hernia occurs in the proportion of 1 in every 21 children. It then goes on decreasing in frequency, there being 1 in 29 at the second year; 1 in 37 at the third year; until, at the thirteenth year, it has fallen to 1 in 77. Shortly after this, its frequency begins to rise again, and then goes on progressively increasing until the close of life; thus, at the 21st year, there is one case in 32; at the 26th year, 1 in 21; at the 35th, 1 in 17; at the 40th, 1 in 9; at 50, 1 in 6; from 60 to 70, 1 in 4; and from 70 to 75, 1 in 3. In women, hernia most frequently occurs from the 20th to the 50th years.

Occupation.—Those occupations in which the individual is exposed to violent muscular efforts, more particularly of an intermitting character, predispose strongly to the occurrence of hernia; and in these employments the tendency to the disease is often greatly increased by the injurious habit of wearing tight girths or belts round the waist, which, by constricting the abdomen, throw the whole pressure of the abdominal contents upon the inguinal regions.

CONDITIONS PRESENTED BY HERNIA.—The conditions in which a hernia may be found are very various, and entail corresponding differences in the result and treatment of the affection. When first formed, most hernie may be said to be *Incomplete*, being for a time retained within the orifice of the canal through which they eventually protrude. When they have passed altogether beyond the abdominal walls, they are said to be *Complete*; and this is the condition in which they are usually presented to the surgeon. A hernia may also be *Reducible*, *Irreducible*, or *Strangulated*.

REDUCIBLE HERNIA.

A hernia is commonly at first *Reducible*; that is to say, it may readily be pushed back into the cavity of the abdomen, protruding again when the patient stands up, holds his breath, or makes any exertion, and having a distinct and forcible impulse on coughing. Though the hernial contents, in these cases, are reduced into the abdomen, the sac is not; it almost immediately contracts adhesions to the cellular tissue, by which it is firmly fixed.

in its new situation ; though in some particular cases, as we shall hereafter see, it may be pushed back.

APPLICATION OF TRUSS.—In the Treatment of a reducible hernia, the object is, by the application of a proper truss, to retain the protrusion within the cavity of the abdomen. In order to do this, the patient must be provided with a proper kind of truss, adapted to the particular nature of the hernia. In umbilical and ventral ruptures, an elastic pad and belt may most conveniently be used. In selecting the truss, care should be taken that the spring be of proper strength, adapted to the size and power of the individual ; and that it be properly shaped, so that it does not touch any part of the abdominal wall, but merely bears upon the points of pressure and counter pressure. The pad should be convex, and firmly stuffed, and of sufficient size to press not only upon the external aperture, but upon the whole length of the canal. Before applying the truss, the hernia must be reduced, by placing the patient in the recumbent position, relaxing the muscles by bending the thigh upon the abdomen, and pressing the tumor back in the proper direction ; the truss should then be put on, and be worn during the whole of the day ; indeed, the patient should never be allowed to stand without wearing it. At night, it may either be left off altogether, or a lighter one applied. In some cases, the skin becomes irritated by the pressure of the pad ; under these circumstances, an elastic air-cushion may be used, or the parts subjected to pressure may be well washed with spirit lotion. The truss may be known to fit by testing it in the following way. The patient should be made to sit down on the edge of a chair, and then extending his legs, opening them widely, and bending the body forward, cough several times. If the hernia do not slip down behind the pad on the trial, we may be sure that the truss is an efficient one, and will keep the rupture up under all ordinary circumstances.

RADICAL CURE OF HERNIA.—Various means have been devised in order to effect the radical cure of a reducible hernia. The only plan that is at the same time perfectly safe and permanently successful, is the compression of a well made truss. In this way it not unfrequently happens that the hernia of infants become radically cured ; the same result, however, seldom occurs at a more advanced period of life. In order that compression may succeed in this way, it is necessary that it should not only be applied to the external aperture through which the rupture escapes, but to the whole of the canal. It must also be continued for a very considerable time, for at least a year or two, and care should be taken that during the treatment the rupture is not allowed to descend ; every time it comes down, any good time may have been derived is necessarily done away with, and the treatment has to begin, as it were, anew. After the cure is supposed to have been effected in this way, the application of the truss must be continued for a very considerable length of time, lest by any unfortunate movement the rupture descend again.

The operations that have been devised for the radical cure of hernia are all founded on one of two principles ; viz., the excitation of such an amount of peritonitis in the sac, or its neck, as to cure its obliteration ; or the plugging of the hernial aperture by invagination of the integumental tissue.

If the accomplishment of these conditions would always prevent the recurrence of the rupture, the radical cure might frequently be undertaken. But it is impossible to look upon the agglutination of the walls of the sac, or the closure of the abdominal aperture, as the sole conditions required. To accomplish the radical cure, it would be necessary in many cases to effect changes in the shape and connections of the abdominal contents, to alter the

size of the abdominal cavity, and indeed to modify in various ways many conditions independent of those immediately connected with the hernial protrusion. Many of the means of radical cure, by which obliteration of the interior of the sac or of its neck is sought to be effected by the application of sutures or ligatures, by the introduction of caustics, by excision, scarification, puncture, or injection with tincture of iodine, are attended with so much danger from peritonitis, and are so seldom followed by any good results, that their consideration need not detain us here, the more so as they are universally abandoned by surgeons of the present day.

The operations that are now practised for the radical cure of hernia are conducted on two principles, however much they may be varied in their details by the ingenuity of particular surgeons.

The first principle of treatment consists of invaginating simply a portion of the scrotum, and fixing it in the inguinal canal, where it becomes adherent, and so occludes the aperture of exit. Of this kind of operation Wutzer's is the best example. The second principle of treatment consists in excising a portion of the integumental structures, and then by means of sutures attaching these and the deeper parts together, and thus leading to the consolidation of the canal. Of this, Wood's operation is the best example. The following are the details of these procedures.

Wutzer's Operation.—The late C. W. Wutzer, of Bonn, adopted a plan of radically curing reducible inguinal herniæ, combining the two principles on which the older operations were founded, viz., the agglutination of the neck of the hernial sac by the excitation of inflammation in it, and the closure of the inguinal canal by the invagination of the scrotum; and he carried out these objects in a safer and more successful manner than by any of the methods previously employed. His plan of treatment consists in introducing a plug of the scrotum into the inguinal canal, and fixing it there by exciting adhesive inflammation in the neck of the sac. The details of the operation are as follow. The patient lying on his back, and the hernia being reduced, the surgeon pushes his index-finger up the inguinal canal as high as the internal ring, carrying before it a cone of the scrotal tissues; a box-wood hollow cylinder, about four inches long (Fig. 383, C), well oiled, is then pushed up as the finger is withdrawn, so as to occupy its place in the inguinal canal. Along the interior of this cylinder a flexible gilt-steel needle (A), fixed in a moveable handle, is then pushed, so as to traverse the invaginated scrotum, the hernial sac, and the anterior abdominal wall,

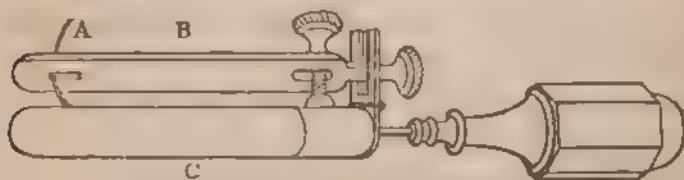


Fig. 383.—Wutzer's Apparatus for Radical Cure of Hernia

through which its point is caused to protrude. A concave box-wood case (B) is then passed over the projecting point of the needle, and fixed by the other end by a screw apparatus to the cylinder (C), so as to compress the inclosed tissues. The apparatus so fixed is left *in situ* for six or eight days; when, some discharge being established, it is withdrawn, and the invaginated scrotal plug supported by lint introduced up its interior, and by a spica bandage tightly applied. The patient is kept quiet for a fortnight longer,

when he is allowed to move about, wearing it months.

This method of treatment is easy of execution, more successful than any that have preceded it, and without the complications and excruciating pains that attend all plans for the radical cure, and without the danger of a dangerous amount of peritonitis between the lower part of the scrotal plug and inguinal canal and ring, and consequent failure of the canal and in the radical cure.

So far as the first objection is concerned, I can be attached to it. I have very often performed it, and have never seen the slightest evidence of a disorganization or other local mischief, except abrasion of the skin in some cases. With respect to the second objection, failures are not unfrequent; but on the other hand, I have now under observation several cases which have resulted, although several years, from the operation.

Wutzer's operation should, of course, not be performed in all cases of reducible inguinal hernia of large size, with a very patent ring, and without the omentum, no good result can be expected, and a radical cure. But on the other hand, if the hernia is small, and of recent occurrence, and if it be confined to the canal and have not as yet become irreducible, the best result may be expected; and there can be no danger to the patient the chance of a radical cure of his hernia by an operation that is not only simple and almost painless.

Wood's Operation.—In order to secure the closure of the canal, and especially the cohesion of the walls of the canal, Mr. John Wood has brought forward another method. This method consists in the approximation of the walls of the canal, by forming the boundary of the hernial canal, by a permanent ligature through a puncture in the skin, and to inguinal hernia, in order to promote the adhesion of the sac and cord from the skin, and to protect the sac and cord from the skin, transplanted by invagination of the skin by the ligatures till adhesion ensues to the skin and spermatic cord. The ligature is so applied as to pass over the places upon the structures forming the posterior wall of the canal, the triangular aponeurosis; and the lower portion of the external oblique muscle, and the lower portion of the external oblique muscle, the pillars of which are made to adhere by the ligatures, which is thus produced between the walls of the canal, the former is made to adhere to the latter, preventing the descent of a hernia into the canal, and the reproduction of the rupture is prevented. When the temporary effusion of lymph is reabsorbed, and the abdominal contents tending to protrude are prevented by the valve-like action of the posterior wall of the canal, itself upon the recently formed adhesions. The operation is a very adjunct in the cure, is rendered unnecessary

Operation.—The patient being laid on his back, with the shoulders well raised, and the pubes and scrotum shaved, the hernia must be reduced and held up by an assistant pressing upon the internal opening. The operator, standing at that side of the patient which is about to be operated on, makes, with a small tenotomy knife, an incision about three-fourths of an inch long through the skin of the scrotum over the lower part of the tumour; or, if this be large, about two and a half inches below the pubic spine. Then the knife, being inserted flatwise between the skin and the fascia, is made to separate them around the incision over an area of about a two-inch circle; a proceeding which the loose attachment of the skin easily allows. The knees of the patient should next be drawn up towards the abdomen, and held together so as to relax the structures connected with Poupart's ligament. The forefinger is next passed through the opening in the skin, and made to invaginate the detached fascia through the external ring into the canal, which is best done by using the right hand for the right side, and vice versa, keeping the palm directed forwards. The invagination of the fascia should be commenced from as low a point as the cutaneous incision will permit, so as to push the invaginating finger as much as possible between the sac of the hernia and the spermatic cord. When the finger is in the canal, its point should reach the internal opening of the hernia, and the cord should be distinctly perceptible to it and protected by it. The point of the finger will then be placed behind the lower border of the internal oblique, and must render this point prominent at the surface by being hooked forward. The surgeon will then be sensible of the edge of the conjoined tendon, raised in relief along the outer border of the invaginating finger. Next, the needle, stout, blunt-pointed, and curved, mounted on a strong handle, is to be passed along the outer border of the finger as far as just beyond the extreme joint, at which point it is made to pass through the conjoined tendon and the external oblique aponeurosis, till it is seen to raise the skin. The latter is then to be drawn upwards and inwards as far as possible before the needle is pushed through it. Then a strong, smooth, hempen ligature, well waxed and then soaped, is passed through the eye of the needle; and the latter is withdrawn, leaving one end of the ligature through the puncture. The invaginating finger is then placed on the outer side of the cord, behind Poupart's ligament, as far from the border of the external ring as possible, raising the ligament on its point. The needle carrying the other end of the ligature is then passed along the inner border of the finger, and pushed through the external pillar close to Poupart's ligament, opposite to the internal ring, the skin being drawn down till the point of the needle appears at the former puncture, through which it is then pushed. The loop of the ligature is then seized and retained in the puncture, the free end being withdrawn with the needle; care being taken to ascertain, before withdrawing the instrument, that the free end of the thread runs in the eye. Next, the forefinger, with the nail turned forwards, is to be placed inside the external ring just above the pubic spine, and pressed upon the posterior wall of the canal, so as to be sensible of the outer edge of the rectus muscle, and of the triangular aponeurosis and conjoined tendon covering it in this situation. At the same time, the scrotum must be drawn well over the groin of the patient, so as to bring the spermatic cord as far outwards over the external pillar of the ring as possible. The point of the invaginating finger will thus cover and protect the cord from injury. The needle is then passed through the triangular aponeurosis and conjoined tendon as far as to the border of the rectus, and pushed through the internal pillar of the external ring about half an inch above the pubic crest. The

skin being drawn downwards and inwards, the made to pass a third time through the original thread is then disengaged from the instrument. We then have two ends and a loop of the puncture in the groin, the former perforating the inguinal fascia, and internal pillar, and the latter the pillar of the ring. With one finger in the ring, traction on the ligature, be able to satisfy obtained on the posterior wall, and that the well drawn together. The ends of the ligature the outer side of the groin, and the loop crossed the median line. A glass or box-wood compress two and a half inches long by one inch wide along the axis of the canal upon the crossed passed over the compress threaded through the end in a loop-knot. The lower extremity of the pubic crest, up to which point the put tucked. A pad of lint is then placed on each it steady, and a linen pad and spica bandage be removed after twenty-four hours; the on sixth day; while the ligature threads may be weeks, according to the amount of action or of the inguinal canal.

IRREDUCIBLE HERNIA

Irreducible Hernia are usually of old date, rarely contain a considerable quantity of the intestine and mesentery. In many instances partly reducible, the greater portion remains the gut which slips up, and the omentum that

CAUSES OF IRREDUCIBILITY.—The irreducibility depends either on its shape, on the existence of nature. If the sac become the seat of an neck become elongated and narrowed, the hernia permanently protruding. So also, the expansion of the omentum, and the narrowing of its neck at the rupture. The existence of adhesions, of contents, or between protruded intestine and the sac, render a hernia irreducible; and most frequently changes in the shape of the sac or the omentum and bladder can never be returned, on account to which reference has already been made.

SYMPTOMS.—An irreducible hernia is inconvenient; it has a tendency to increase if left uncontained, as in some extreme cases it has been known to contain the abdominal viscera, forming an encysted mass of considerable size and weight, in which the penis and scrotum are included. If the irreducible hernia is of small size, it gives little trouble in the part, with dragging pains, and is void of colicky sensations and dyspeptic derangement. In these circumstances, as in a state of considerable enlargement, it becomes strangulated by violent efforts, and is attended with great pain.

TREATMENT.—For the above reasons, it is

rupture of this kind from external violence, but to endeavour to prevent its increase in size. This may best be done by letting the patient wear a truss with a large concave pad, which supports and protects it; provided the rupture be not of too great a size for the application of such an instrument. If its magnitude be very considerable, it must be supported by means of a suspensory bandage. Bransby Cooper has recommended that an attempt should be made to convert the irreducible into a reducible hernia, by keeping the patient in bed for several weeks, on low diet, with the continued application of ice to the tumour; and, if it contain much omentum, giving small doses of blue pill and tartar emetic, so as to promote the absorption of the fat. This plan, which appears to have answered well in some cases, certainly deserves a further trial.

INFLAMED IRREDUCIBLE HERNIA.—The occurrence of inflammation in an irreducible hernia is a serious complication, and one that simulates strangulation very closely. When this complication occurs, the part becomes swollen, hot, tender, and painful; there is not much tension in the tumour, which is seldom increased beyond its usual magnitude; there is a good deal of pyrexia, and symptoms of peritonitis spreading from the vicinity of the inflamed rupture set in. In some cases there is vomiting; but it is not constant, and never feculent, occurring generally early in the disease, and consisting principally of the contents of the stomach; being apparently an effort of nature to get rid of an indigestible meal. If there be constipation, as usually happens in all cases of peritonitis, it is not complete, flatus occasionally passing *per anum*, together with a small quantity of fluid faeces. It is of importance in these cases to observe that the inflammation commences in the body of the sac, and extends into those parts of the abdomen that are contiguous to its neck; the stomachal and intestinal derangements being secondary to this condition.

The *Treatment* of an inflamed irreducible hernia must be directed to the peritonitis which attends it. The application of leeches to the sac and its neck, the free administration of calomel and opium, and the employment of enemata, with strict antiphlogistic regimen and rest, will usually speedily subdue all inflammatory action.

INCARCERATED HERNIA.—An irreducible hernia occasionally becomes obstructed, then constituting the condition termed *incarcerated hernia*. This condition principally occurs in old people, from the accumulation of flatus, or of undigested matters, such as cherry-stones or mustard-seeds, in an angle of the gut. In these cases there is constipation, with eructation, and perhaps occasional vomiting. There may be some degree of pain, weight, or uneasiness about the tumour; but there is no tension in it or its neck, and the symptoms altogether are of a chronic and subacute character.

The *Treatment* of such a case as this should consist in the administration of a good purgative injection; the compound colocynth enema is the best, thrown up as high as possible by means of a long tube. Ice may then be applied to the tumour for about half an hour; and then the taxis, as will afterwards be described, may be used under chloroform. The ice may be omitted in those cases in which, on handling the tumour, gurgling can readily be felt; but the taxis should always be used, as by it the incarcerated gut may be partially emptied of its contents; or if any additional protrusion should have happened to have slipped down, this may be returned. After these means have been employed, an active purgative, either of calomel or croton oil and colocynth, should be administered; and, if any inflammation exists, this must be treated as already described.

STRANGULATED HERNIA.

A hernia is said to be *Strangulated* when a portion of gut or omentum that is protruded is so tightly constricted that it cannot be returned into the abdomen; having its functions arrested, and, if not relieved speedily, running into gangrene. This condition may occur at all periods of life, being met with in infants a few days old, and in centenarians. It commonly arises from a sudden violent effort, by which a fresh portion of intestine is forcibly protruded into a previously existing hernia, which it distends to such a degree as to produce strangulation. But, though old herniæ are more subject to this condition than recent ones, it may occur at the very first formation of a hernial swelling, the gut becoming strangled as it is protruded. There are therefore two distinct kinds of strangulation. One may be said to be of a passive kind, chiefly occurring in elderly people, the subjects of old and perhaps irreducible herniæ; which, in consequence of some accidental circumstance, become distended by the descent of a larger portion of intestine than usual, and this, undergoing constriction and compression at the neck of the sac, gradually becomes strangulated. The other kind of strangulation is most frequent in younger individuals; in it the symptoms are more active, the bowel becoming protruded in consequence of violent exertion, and undergoing rapid strangulation, the tension of the part not having been lessened by the previous long existence of an irreducible hernia.

MECHANISM OF STRANGULATION.—Strangulation has been attributed either to a spasmodic action of the walls of the aperture through which the hernia protrudes, or to changes taking place in the protruded parts, subsequent to and occasioned by their constriction by the tissues external to them. The strangulation cannot, I think, ever be regarded with justice as of spasmodic character; the aperture in the abdominal wall, through which the hernia escapes, being tendinous or fibrous, and certainly not in any way contractile, though the action of the abdominal muscles may undoubtedly increase the tension of its sides. The continued and permanent character of the strangulation, when once it has taken place, would also discountenance this opinion; those forms of hernia, indeed, as the ventral, which occur in purely muscular structures, are very rarely strangulated, and, when they are so, the constriction is generally occasioned by the formation of dense adventitious bands upon or within the sac, and not by any muscular agency.

Strangulation is characterised by congestion of the protruded part induced by the constriction to which they are subjected; the mechanism being as follows. A knuckle of intestine, or piece of omentum, is suddenly protruded during an effort of some kind. This immediately becomes compressed by the sides of the narrow aperture through which it has escaped; the return of its venous blood is consequently interfered with, and swelling and oedema rapidly ensue, together with stagnation of the blood in it. If the constriction be excessively tight, the walls of the ring being very hard and sharp, the part that is so strangulated may be deprived of its vitality in the course of a few hours. If the strangulation be less severe, the congestion will run into inflammation, the changes characteristic of this condition speedily supervening. In proportion as the congestion augments, and the inflammation comes on, the return of the protruded parts is necessarily rendered more difficult by the increase of their swelling.

SEAT OF STRICTURE.—The stricture is most commonly situated outside the neck of the sac, in the tendinous or ligamentous structures surrounding

it; not unfrequently in the altered and thickened subserous cellular tissue. In other cases, and indeed with great frequency, it is met with in the neck of the sac itself (Fig. 384), which is narrowed, elongated, and tubular; or constricted by bands that are incorporated with it. More rarely it exists in the body of the sac, which may have assumed an hour-glass shape. In some cases, it would appear as if this particular shape were owing to an old hernia having been pushed down by a recent one above it. The stricture is sometimes, though by no means frequently, met with inside the sac, consisting of bands of adhesions stretching across this, or of the indurated edge of an aperture of the omentum through which a portion of the gut has slipped.



Fig. 384.—Stricture in the Neck of the Sac.

LOCAL EFFECTS OF STRANGULATION.—The changes induced in the strangulated parts result from the pressure of the stricture, and the consequent interference with the circulation through them. If the strangulation be acute, that portion of intestine which lies immediately under the stricture will be seen to be nipped or marked by a deep sulcus, occasioned partly by the pressure to which it has been subjected, and partly by the swelling of the congested tissues beyond it. The changes that take place in the protruded intestine rapidly increase in proportion to the duration of the strangulation. The tightness of the stricture and the acuteness of the strangulation have, however, even more to do with these changes than its duration. I have seen the bowel so tightly nipped that, though the strangulation had only existed eight hours when the operation was performed, the vitality was lost in the part constricted (Fig. 390); and in other cases I have known the part to recover itself, although strangulation had lasted for five or six days before the operation was performed.

The first change that takes place in the protruded parts in a case of strangulated hernia is their *congestion*; this rapidly runs on to inflammation, and speedily terminates in gangrene. The protruded bowel becomes, at first, of a claret, maroon, or purplish-brown colour, sometimes ecchymosed on the surface, with thickening and stiffening of its coats, owing to effusion into their substance; some liquid is also usually poured out into its interior. In this stage, that of congestion, the omentum will also be found with its veins a good deal congested. When inflammation has set in, the bowel preserves the same colour as in the congested condition, but usually becomes coated here and there with flakes of lymph, which give it a rough and villous look; the omentum has a somewhat rosy tinge, and there is usually a good deal of reddish fluid poured out into the sac. When *gangrene* occurs, the bowel loses its lustre and polish, becoming of an ashy grey, or dull black colour, soft and somewhat lacernable, so that its coats readily separate from one another; the serous membrane especially peeling off. The omentum is dark purplish, or of a kind of dull yellowish grey; and there is usually a considerable quantity of dark turbid serum in the sac, the whole contents of which are extremely offensive. Most usually, when gangrene occurs in a strangulated rupture, inflammation of the sac and its coverings takes place, accompanied, after a time, by a reddish-blue or congested appearance and some tenderness on pressure; and, if the part be left unreduced, eventually by emphysematous crackling. If the case be left without being relieved,

gangrene of the skin will at last take place; the sac giving way, and the fecal matters being discharged through the softened and disintegrated tissue. Under such circumstances as these—which, however, are very rarely met with at the present day—the patient usually eventually dies of low peritonitis from extension of the inflammation to the serous membrane. No effusion, however, of feculent matter will take place into the peritoneal cavity, even under such unfavourable conditions; the portion of bowel immediately within the stricture becomes adherent by plastic matter to the peritoneum on its internal surface, and thus the escape of any extravasation into the cavity of the abdomen is prevented. It does not always follow that there is any external evidence of the occurrence of gangrene within the sac; and the bowel is frequently nipped to such an extent as to prevent its regaining its vitality, without any unusual condition being presented until the sac is actually laid open and the intestine examined.

In the more advanced cases of strangulated hernia, the peritoneum always becomes inflamed, usually to a considerable extent; the disease affects a diffuse form, and is accompanied by the effusion of turbid serum, often of a very acrid and irritating character, and mixed with flakes of lymph, sometimes to such an extent as to give it a truly puriform appearance. The glutinous lymph mats together contiguous coils of intestine, often appearing to be smeared over them like so much melted butter.

SYMPTOMS.—The symptoms are of two kinds: 1. Those affecting the Tumour; and 2. Those influencing the Constitution generally.

1. *Local Symptoms.*—The tumour, if the hernia be an old one, will be found to be increased in size; or it may have appeared for the first time. At the moment of strangulation it will generally be found to be hard, tense, and rounded, more particularly if it be an enterocele. When, however, the hernia is in a great measure omental, it is not infrequently soft and doughy, though strangulated. It seldom increases in size after strangulation has occurred, as no fresh protrusion can take place below the stricture, but it may have known it to be greatly augmented in bulk after the strangulation has existed for some hours, by the effusion of serum into the sac. If the hernia have previously been reducible, it can no longer be put back; and there is no impulse in it, nor increase in its size on coughing, the stricture preventing the transmission of the shock to the contents of the tumour; and in this way, as pointed out by Luke, the situation of the constriction may sometimes be ascertained by observing at what point the impulse ceases.

2. *Constitutional Symptoms.*—So soon as the strangulation has occurred, intestinal obstruction takes place, and the patient becomes uneasy and restless. If the constriction be of an active character, he will be seized with acute pain in the part, which speedily extends to the contiguous portion of the abdomen, assuming the characters of peritoneal inflammation. The first thing that happens when intestine is strangulated, whether a large coil be constricted, or a small portion only of the diameter of the gut be nipped, is an arrest of the peristaltic movement of the part implicated, and the occurrence of obstruction to the onward course of the intestinal contents is followed by constipation, vomiting, and colicky pains. The constipation is always complete, neither feces nor flatus passing through; the bowels may sometimes act once after the strangulation has occurred from that portion which lies below the seat of constriction, but they cannot, of course, empty themselves thoroughly, nor from above the strangled part. Vomiting usually sets in early, and is often very severe and continuous, with much retching and straining, at first the contents of the stomach are ejected, with some bilious matters, but afterward the vomiting becomes feculent, or stercoraceous, owing to inverted per-

staltic action extending as far down as the constricted part of the gut. These symptoms are attended by colicky and dragging pains about the navel. They are more severe in their character when the strangulation is acute and the hernia is intestinal, than when it is passive, and the rupture omental. They occur equally in the incomplete as in the complete forms of the disease; indeed, it not unfrequently happens that the hernial tumour may be so small as to have escaped observation; the occurrence of the above-mentioned symptoms being the first indication of the probable nature of the mischief. Hence, it is well always to examine for hernia when called to a patient suddenly seized with constipation, vomiting, and colicky pains, even if told that no tumour exists.

After the strangulation has existed for some time, the inflammation that occurs in the sac extends to the contiguous peritoneum, accompanied by the ordinary signs of peritonitis, such as tension of the abdominal muscles, tenderness, with lancinating pains about the abdomen, and tympanitis. The patient lies on his back with the knees drawn up, has a small, hard, quick, and perhaps intermittent pulse, a dry tongue, which speedily becomes brown, and a pale, anxious, and dragged countenance, with a good deal of heat of skin, and inflammatory fever. In some cases, this is of a sthenic type; but, in the majority of instances, especially in feeble subjects, it assumes the irritative form. When gangrene of the rupture takes place, hiccup usually comes on, with sudden cessation of pain in the tumour, an intermittent pulse, cold sweats, pallor, anxiety, rapid sinking of the vital powers, usually with slight delirium; and death speedily occurs.

Modifications of Symptoms.—The symptoms just described are those which are usually met with in strangulated hernia. They may, however, be modified in some important respects.

1. There may be little or no tension in a strangulated hernia, the tumour continuing soft and lax; this is especially the case when the hernia contains omentum, and in congenital hernia when strangulated. It may also occur in the case of double hernia on the same side, in consequence of the outer sac being empty, or merely filled with serum, and the posterior one being protruded against this and strangulated, but its tension being masked by the lax state of the outer one.

2. Vomiting sometimes does not take place from first to last, there being at most a little retching; at other times the patient vomits once or twice, and then there is no recurrence of this symptom so long as he remains quiet, and keeps the stomach empty; but on moving or taking nourishment of any kind, even fluids, it comes on again, and thus the surgeon may elicit this symptom, should it be necessary in a diagnostic point of view.

3. Extensive peritonitis, with copious effusion of a puriform liquid, may occur without any pain, and with but little tenderness; the anxiety of countenance and sharpness of pulse being the only symptoms that lead to a suspicion of its existence.

4. Death may result from exhaustion consequent on vomiting and peritonitis, without any sign of gangrene in the constricted portion of intestine.

Diagnosis.—The diagnosis of strangulated hernia requires to be made from the following conditions

1. *Obstructed Irreducible Hernia.*—In this there are no acute symptoms, and the rupture will generally be found to be a large one of old standing. It may become somewhat tense and swollen, but is not tender to the touch, and always presents a certain degree of impulse on coughing. There is no sign of peritonitis. There may be constipation; but there is no vomiting, or, if there be any, it is simply mucous and bilious, consisting of the

contents of the stomach. The speedy rest by the treatment already indicated as proper doubt as to the nature of the affection.

2. *Inflamed Irreducible Hernia.*—Here it is in the tumour, with pyrexia, and some general vomiting; or, if the patient have vomited, it continues to do so with the same degree of violence he would if the peritonitis were the result of constipation is not absolute and entire, but usually passes.

3. *General Peritonitis conjoined with Hernia.*—This is extremely difficult, especially if the hernia is large. In such cases, however, it will be observed that the tumour is at a distance from the sac; that there will be no tenderness there, that it is simply of mucus and that the constipation is by no means obstinate.

4. In *Double Hernia*, one tumour may be reducible, the other though irreducible. Under these circumstances it is difficult to determine which one is the seat of the inflammation, but may be ascertained by observing greater tenderness at the neck of the strangulated than of the unobstructed.

Besides these various conditions of hernia, there are other tumours of the abdomen with strangulation, there are other tumours of the abdomen: but these we shall have to consider in the chapter on the forms of hernia.

TREATMENT.—The treatment of strangulated hernia is one of the most important subjects in surgery. The object is the removal of the constriction from the stricture, effected either by the Reduction of its Contents, or by the Stricture.

Taxis.—The reduction of the hernia is effected by the taxis, by which is meant the various manual means of reducing the rupture back. The taxis, when properly employed, is attended by any serious consequences to the patient, but is attended by death; and, out of 293 cases of hernia reduced by the taxis in the London Dispensary, it was unfrequently followed, however, by rather serious consequences, which might probably, in some instances, have been avoided by very abundant bleeding, probably owing to the rupture of some of the vessels of the gut. In using the taxis, it should be employed, and no undue force should ever be used, and no undue force should ever be effected by violence: the resistance should be overcome by forcible pressure; and a vast deal of time is lost in fighting against it the tender and inflamed gut, and in so doing to be bruised, or even perhaps torn. The taxis should not be continued beyond half an hour; if it be properly employed, if reducible, will probably go back. If it be employed improperly, for a lengthened period, and by the protruded part becomes ecchymosed, inflammation; and the chances of recovery after it is reduced are lessened. When the parts are much inflamed, it should be reduced with great caution; and, if it have been reduced,

surgeon, it is better not to repeat it. When gangrene has occurred, the taxis should never be employed; as the putting back of the mortified gut into the abdomen would be followed by extravasation of feces and fatal peritonitis.

In using the taxis, it should be borne in mind that there are two obstacles to overcome; the resistance of the parts around the ring, and the bulk of the tumour. The first may be somewhat lessened by relaxing the abdominal muscles, and consequently diminishing the tension exercised upon the tendinous apertures and fasciæ of the groin. In order to effect this, the patient should be placed in a proper position, the body being bent forwards, the thigh adducted, and semi-flexed upon the abdomen; the surgeon may then, by employing steady pressure on the tumour, endeavour to squeeze out some of the flatus from the strangled portion of intestine, and thus to effect its reduction. In doing this, the neck of the sac should be steadied by the fingers of the left hand; whilst, with the right spread over the tumour, the surgeon endeavours to push it backwards, using a kind of kneading motion, and sometimes in the first instance drawing it slightly downwards, so as to disengage it from the neck of the sac. The direction of the pressure is important; it should always be in the line of the descent of the tumour. These means may be employed as soon as the patient is seen by the surgeon, when, by steadily carrying on the taxis for a few minutes, he will perhaps hear and feel a gurgling in the tumour, which will be followed by its immediate reduction. If the patient be thin, and the outline of the aperture through which the hernia escapes tolerably defined, I have succeeded in reducing the protrusion, after failure of the taxis in the ordinary way, by passing the tip of my finger or the nail under the edge of the ring, and pulling this firmly and forcibly on one side, so as to steady and at the same time dilate it, pressure being kept up on the tumour with the other hand. This manoeuvre can be practised with more facility and success in femoral hernia, where the upper edge of the saphenous opening is sharply defined, but may also successfully be had recourse to in inguinal and umbilical protrusions. In some cases reduction appears to have been facilitated by placing the patient on his head and shoulders, and raising the body in the vertical position whilst the taxis was being employed. Should, however, reduction not ensue, it will be desirable to have recourse at once to further means, the object of which is, by relaxing the muscles and lessening the bulk of the tumour, to enable the hernia to be reduced.

Auxiliary Measures.—The means to be employed must be modified according to the condition of the strangulation, whether it be of the active or of the passive kind. If it be very acute, occurring in a young, robust, and otherwise healthy subject, the patient may have about twelve or sixteen ounces of blood taken away from the arm; he should then be put into a hot bath, where he may remain for twenty minutes or half an hour, or until he feels faint; and, whilst he is in the bath in this condition, the taxis should be employed. If it do not succeed, he should be taken out, wrapped up in blankets, and have chloroform administered. When he is fully under the influence of this agent, which is certainly the most efficient which we possess for relaxing muscular contraction, the taxis may be tried once again. Should it still fail, operation should be immediately proceeded with. No good can possibly come of delay in these cases, and repeated attempts at the taxis should be carefully avoided. If the hernia do not admit of reduction in the early stage of the strangulation, it will necessarily be much less likely to do so when the parts, squeezed and bruised by much manipulation, will have had their congestive condition greatly increased. The frequent employment

of the operation without opening the sac, of late surgeons much less averse to early division of the case.

When the strangulation is less acute, or occurs in a robust subject, it is well to omit the bleeding, and use chloroform.

When the strangulation is of a passive character in elderly people, other measures may be adopted to reduce the bulk of the tumour; which, rather than the taxis, is the chief obstacle to reduction in these cases. Especially when the tumour is large and not very tender, it is well to dispense with the hot bath, which has sometimes a congestive effect that may already exist in the hernia. In some cases seen a strangulated rupture enlarge considerably under the influence of the bath. In such cases, more time may be spent in reduction than in very acutely strangulated hernia. As a first practice to commence the treatment by the administration of an enema, which, by emptying the lower bowel, will alter the contents, and may materially facilitate the reduction. The best enema is one of gruel and castor-oil, with a little opium added to it; it should be injected through a catheter, and run up into the gut, and with a moderate degree of pressure. Great care must be taken that no injury be done to the rectum. It is not necessary to give such a caution as this, were it not for some years ago, by two very excellent practitioners, in a case of strangulated femoral hernia, to whom an enemata of water had been administered; and as this had not appeared to have gone up the bowel, they suspected it had passed out of the rectum into the surrounding cellular tissue. However, did not seem to be suffering from this. In the case of strangulation were urgent, I operated on the day it occurred, apparently from exhaustion, in about an hour after the hernia was found. On opening the body, it was found that the rectum had been pushed up and fluid injected into the meso-rectum, separating the hernia from whence it had extended into the general subperitoneal space, which contained a quantity of the liquid; some of the liquid had entered the peritoneal cavity.

In the large hernia of old people, more especially in the male, in which there is a good deal of flatus, after the taxis has been tried, a bladder of ice may be applied for three or four days, and then Chloroform may then be given, and the taxis continued. Of late years, indeed, I have been in most cases almost solely to chloroform as a relaxing agent, and have dispensed with the use of the warm-bath. If the taxis is conveniently used without too much delay, it should be continued until a patient with strangulated hernia at once yields to the taxis for a period not exceeding half an hour, and then once proceed to operation without any further delay. The taxis is not only useless, but injurious by bruising the hernia.

Persistence of Symptoms after Reduction.—In some cases of hernia, the symptoms of strangulation may occur again. The recurrence toward occurrence may arise from three distinct causes. First, the hernia may have been reduced in mass (*vide p. 999*); secondly, the sac may have existed within the sac—the taxis having over-

the failing to influence that within the sac; 3. The gut may have been so severely nipped that, although all constriction has been removed, the peristaltic action is not restored, the constricted portion of bowel falling into a state of gangrene. The diagnosis of these several conditions may possibly be made by attention to the following circumstances. In the reduction of *mass* the tumour has slipped up without any gurgle; the canal is very open, and no trace of sac can be felt in it, but a rounded tumour, possibly at the upper part, on coughing. In the case of *internal adhesions* there will have been no gurgling, but the canal is still filled by the sac; the abdominal apertures are not preternaturally patent and distinct. In the case of *extreme nipping* and consequent paralysis of a portion of the gut, gurgling will have been felt and heard in effecting the taxis, which does not happen in either of the other conditions, and the symptoms of intestinal obstruction will not be quite complete. The vomiting will lose its stercoraceous character, and probably some flatus will pass.

The *Treatment* of these different conditions is full of difficulty and of anxiety to the surgeon. As a general rule, I think that the proper practice in all cases when the symptoms of strangulation, especially stercoraceous vomiting, continue *unrelieved and undiminished in severity* for some hours after the apparent reduction of the hernia, is to cut down upon the canal, expose the sac, and, if that be found still strictured, as will be explained at p. 1001, divide the constriction. Should the hernia not have been reduced "in time," it might possibly be found that a small knuckle of intestine is still gripped at the inner and deeper ring; but should that not be the case, it will, I think, be safer not to push any exploration into the abdominal cavity with the view of discovering the possible existence of unrelieved internal strangulation, the presence of which would be highly problematical, and, if existing, could scarcely admit of discovery. The safer and wiser plan under such circumstances appears to be, to leave the wound open, with a poultice and a light compress over it, and to give the patient the chance of the formation of an artificial anus on the sloughing of the strangulated or badly nipped knuckle of intestine; a result that I have more than once witnessed about the fourth or fifth day, the patient ultimately recovering.

In some cases, where the nipping of the strangulated intestine has been severe, yet not sufficient to arrest permanently the peristaltic action or to destroy its vitality, constipation and retching, with nausea, may continue; and the tumour, if the hernia have been small and deeply seated (more particularly if femoral), may continue to be felt, though less tense than before; consisting simply of the thickened and inflamed sac, with serous fluid in it. Under these circumstances, we must be careful not to operate. I have, on two or three occasions, seen an empty sac operated on, to the annoyance of the surgeon and danger of the patient. The mistake may be avoided by observing that the symptoms gradually lessen in severity by waiting, and that the tympanitis subsides, the abdomen becoming flat and supple.

The length of time during which the congestive condition of the bowel will continue after a strangulated portion of intestine has been reduced, is very considerable. In a case of strangulated femoral hernia which was some time ago under my care, reduction was effected, but, strangulation recurring at the end of twelve days, an operation became necessary; this was performed, and the patient died on the eighth day after it, or the twenty first from the first strangulation. On examination, the small intestine was found *concreted in two distinct portions*, each of which was about eight inches in

length; several feet of healthy gut intervening between them. One of the congested portions lay opposite the wound, and was evidently the intestine that was last strangulated. The other was altogether away from the seat of operation, but was equally darkly congested, being almost of a black colour, and was clearly that portion which had been constricted some time previously, and which, although twenty days had elapsed, had not as yet recovered itself.

After the taxis has been fairly employed for a sufficient time, and has not succeeded in reducing the hernia, the operation must be proceeded with. It is impossible to lay down any definite rule as to the time that it is prudent to continue efforts at reduction; but it may be stated generally that, after the different adjuvants of the taxis which the surgeon may think it desirable to apply have been fairly tried and have failed, the operation should be undertaken without further delay. There are few surgeons who will not at once acknowledge the truth of the remark of the late Mr Hey of Leeds—that he had often regretted performing this operation too late, but never having done it too early. It is true that cases are occasionally recorded, in which after four or five days of treatment the hernia has gone up; but it is very rare to meet with such cases in practice; and, in all probability, in delaying the operation in the hope of finding one such case, the lives of dozens of patients would be sacrificed. Luke has shown, as the result of the experience at the London Hospital, that the ratio of mortality increases greatly in proportion to the length of time during which the strangulation is allowed to continue. Of 69 cases of strangulated hernia operated upon within the first 48 hours of strangulation, 13 died, or 1 in 5·7; whilst of 38 cases operated on after more than 48 hours had elapsed, 15 died, or 1 in 2·5. Indeed, one chief reason of the greater mortality from operations for hernia in hospital than in private practice, probably arises from the fact that much valuable time is frequently consumed before assistance is sought, or in fruitless efforts to reduce the swelling before the patient's admission. Not only is time lost in this way, but the bowel is often bruised and injuriously squeezed, so that the inflammation already existing in it is considerably increased.

OPERATIONS FOR STRANGULATED HERNIA.

The operation for strangulated hernia may be performed in two ways, either by opening the sac, exposing its contents, and dividing the stricture wherever it is situated, *from within*; or it may be done by dividing the stricture *outside*, without opening the sac. In either case the great object of the operation, the division of the stricture by the knife, is the same, but the mode in which it is effected is different. We shall first describe the operation in which the sac is opened; afterwards that in which it is not, and then briefly compare the two procedures.

OPERATION IN WHICH THE SAC IS OPENED.—*Exposure of the Sac*.—The patient having been brought to the edge of the bed, or placed on a table of convenient height, the bladder is emptied, and the parts that are the seat of operation are shaved. An incision of sufficient length is then made over the neck of the sac, this may be best done by pinching up a fold of skin, pushing the scalp through its base with the back of the instrument turned towards the hernia, and then cutting upwards (Fig 385). A linear incision is thus made, which may be extended at either end if necessary; the dissection is then carried through the superficial fascia and fat with the scalpel and forceps. If any small artery spout freely, it had better be tied at once, lest the bleeding obstruct the view of the part in the subsequent steps.

of the operation. As the surgeon approaches the sac, more caution is required, particularly if the subserous cellular tissue be dense, opaque, and innervated. The surgeon must pinch this up with the forceps, make a small incision into it, introduce a dissector, and lay it open upon this, or on the finger (Fig 385). If it be thin and not opaque, so as to admit a view of the subjacent parts, he may dissect it through with the unsupported hand. In this way he proceeds until the sac is reached, which is usually known



Fig. 385.—Operation for Hernia. Division of the Skin.

by its rounded and tense appearance, its filamentous character, and by the arborescent arrangement of vessels upon its surface. In some cases the surgeon thinks that he has reached the sac, when in reality he has only come upon a deeper layer of condensed cellular tissue in close contact with it; here the absence of all appearance of vessels, the dull and opaque character of the tissue and its more solid feel, together with the absence of the peculiar tension that is characteristic of the sac, will enable him to recognise the real state of things. In other cases, it may happen that the sac is so thin, and the superficial structures are so little condensed, that the surgeon lays it open in the earlier incisions before he thinks he has reached it.



Under these circumstances, a portion of the intestine protruding might be mistaken for the sac. This dangerous error may be avoided by observing the peculiarly smooth and highly polished appearance presented by the dark and congested gut, the absence of arborescent vessels, and the non-existence of any adhesions between its deeper portions and the tissues upon which it lies. If the sac be prematurely opened and omentum protrude, the granular appearance and peculiar feel of this tissue will at once cause its recognition.

Fig. 386.—Operation for Hernia. Incision of 8 baserous cellular tissue.

Opening the Sac.—The sac, having been exposed, must be carefully opened; this should be done towards its anterior aspect; and if it be a small one, at its lower part. It may best be done, if the sac be not very tense, by seizing a portion of it between the finger and thumb, and thus feeling that no intestine is included; a small portion of it is then pinched up by the forceps, and an opening is made into it by cutting upon their points with the edge of the scalpel laid horizontally. If the sac be very tense, it cannot be pinched up in this way, and then it may best be opened by introducing the point of a fine hook very cautiously into its substance, raising up a portion of it in this way, and then making an aperture into it. *There is little risk of wounding the gut in doing this; for, as the tension of*

the sac arises from the effusion of fluid into it, posed between it and the gut. In these cases out in a full jet, and occasionally exists in a vein have seen at least a pint of slightly bloody serum of an old strangulated inguinal hernia. Most not more than from half an ounce to an ounce; is considerably less than this. In some instances then it becomes necessary to proceed with external sac, as the gut or omentum is applied closely cases as these the sac is not unfrequently sufficient the surgeon to see its contents through it: opposite to the omentum, or to any small mass slitting through it. The opening, having opened

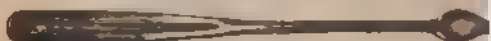


Fig 387.—Director on which the Sac is

may be extended by the introduction of a broach which it is to be slit up to a sufficient extent to its contents.

Division of the Stricture.—The next point is of the stricture; and this requires considerable the neighbouring parts of importance, or the gut structures in the vicinity of the stricture are proper direction, in accordance with ordinary which will be described when we come to operation. All injury to the intestine is prevented finger of the left hand up to the seat of stricture underneath it, and dividing the constriction by



Fig 388.—Hernia knife

having a very limited cutting edge (Fig. 388), guide the knife, the intestine will be in contact with the instrument may be slid under that portion of it which



Fig 389.—Mode of using the Hernia knife.

finger, upon its flat side, as represented in Fig. 389, keep the bowel out of the way, and detect the stricture posed between the edge of the knife and the finger.

During the division of the stricture, the gut must be protected from injury by the knife.

hand over them in such a way that they cannot be touched by the edge of the instrument; or they may be protected by an attentive and careful assistant.

In some cases, the stricture is so tight that it is at first almost impossible to get the edge of the nail underneath it. The surgeon will, however, generally succeed in doing so, by directing his assistant to draw down the oil of intestine, so as to loosen it, as it were, from underneath the stricture; he will then usually succeed in passing his finger up in the middle of the oil, where the mesentery lies. So soon as the blunt end of the hernia-knife has been passed under the stricture, its sharp edge must be turned up, and the constriction divided in a proper direction, to a very limited extent, from the one-eighth to the quarter of an inch.

Reduction.—The intestine and omentum, having been examined, must be dealt with according to the condition in which they are found; as will be described at pp. 989-992. If these structures be sufficiently healthy to admit of reduction, the intestine should first of all be replaced. This must be done by pushing it back with as much gentleness as possible, and chiefly by using the index-fingers. When it has slipped up into the abdomen, the omentum must be returned in the same way. In reducing the hernial protrusion, after the sac has been laid open, care should be taken that the margins of this are firmly held down by means of a pair of forceps; lest it, together with its contents, be returned *en masse*, the stricture being undivided. After reduction, the surgeon should pass his finger up into the canal through which the hernia has descended, and feel that all is clear. A suture or two should next be applied through the lips of the wound, with a few cross strips of plaster between them, a long pad of lint laid over it, and a spica bandage to retain it all in proper position, and to prevent the protrusion of the hernia again during a fit of coughing, or a muscular effort. I have, however, seen the pressure of the pad occasion so much venous hemorrhage, by producing congestion of the venous tissues in the neighbourhood of the wound, as to require to be laid aside, and the wound to be simply dressed. About the third or fourth day the sutures may be removed, and water-dressing applied. If inflammation or suppuration should set in, the part must be well poulticed; and care should be taken to leave the most dependent aperture free, as otherwise the pus formed in the external incisions may flow back through the internal aperture into the peritoneal cavity, and occasion fatal inflammation. Indeed, I think it desirable that union of the lips of the wound after the operation for hernia should not take place by the first intention; as it not unfrequently happens when this occurs, that the pus and other discharges, not finding a ready outlet, may either be diffused between the muscular planes of the abdominal wall, occasioning sloughing and abscess; or, returning into the peritoneal cavity, may excite inflammation of it—a result which I have more than once seen occur.

After-Treatment.—The patient should be kept quiet in bed; and, if there be no sign of peritonitis, should have an opiate given him. The bowels will probably act in the course of the first twenty-four hours; should they not do so, a castor-oil and gruel enema may be thrown up. It is, I think, of very great importance not to administer any purgatives in these cases, and to take little heed of the bowels not acting, even for three or four days after the operation. If the mechanical obstacle have been removed, will be sure to recover their proper action; though, in consequence of the gut having been severely constricted and almost wounded by the pressure of the stricture, it may require to be left quiet for a few days before it

recover its peristaltic action. The administration of further irritating it, will increase the risk of doing so, and probably do much harm. The patient, of course, on the simplest and most unirritating diet--indeed, barley-water and ice for the first day or two, and but no solid food must be given till the bowels and peritonitis has passed.

ACCIDENTS AND MODIFICATIONS OF THE DISEASE. Having been thus described, we have next to consider the accidents attending it, or modifications which it may assume. Peritonitis, the Management of the Intestine, the Management of Adhesions and of the Omentum, the Management of Arteries, Sloughing of the Sac, Fistula.

Peritonitis after Operation.--The great danger attending operations for hernia is the supervention of peritonitis, which existed before the operation, may be impending, or at all events greatly increased by the operation of the peritoneum. Two distinct kinds of peritonitis for hernia; the active or acute, and the passive.

Acute Peritonitis is commonly met with in otherwise healthy, who are the subjects of the disease. The ordinary symptoms of acute idiopathic inflammation is tenderness of a diffused character, with lameness on his back, with his knees drawn up, his pulse quick, hard pulse, a dry tongue, and much difficulty of respiration is principally thoracic, and tympanic bowels are usually constipated, though sometimes of this form of herniary peritonitis is best combated by phlogistic principles; the disease is an active inflammation, and means must be taken to subdue it. This may be done by section and the application, perhaps repeated, of blisters to the abdomen; calomel (gr. ij.) and opium (gr. i.) administered every fourth or sixth hour, and barley-water and ice. As the inflammatory action continues which is occasioned by it will be relieved by administering any purgatives. The tympanic bowels are relieved by turpentine enemata, and any lurking tenderness by blisters.

Latent or Passive Peritonitis appears to be of a different character. It chiefly occurs in old people, or in those who are especially apt to follow upon inflammation of the bowels, or sequent suppuration; or it may occur in consequence of a diseased action from the cutaneous wound, and in a morbid condition induced by the strangulated hernia, especially, in whom all disease is apt to assume a chronic form. It is peculiarly liable to occur. In some cases, the appearance of any marked local symptoms or uneasiness in the abdomen, but, two or three days after the operation, the patient becomes depressed, with a quick and feeble pulse, a tumid and tympanic abdomen, and loss of strength. In the majority of cases, however, the signs of peritonitis are present. After death the abdomen is found to contain a quantity of turbid serous

lymph ; in many instances in such quantity as to give it a puriform appearance, and not unfrequently matting together the coils of intestine. In the *Treatment*, it is necessary to support the patient, and in some instances even to administer stimulants, such as ammonia, the brandy-and-egg mixture, &c. Depleting measures of all kinds are quite inadmissible ; and, indeed, the remedy that offers most prospect of benefit to the patient is opium, in full doses, one grain being given every third or fourth hour until some effect is produced upon the constitution. Opium not only acts as a useful stimulant in these cases, but has a tendency to allay the increased vascular action. At the same time, a blister to the abdomen, to be dressed with mercurial ointment, may be advantageously employed ; and turpentine enemata may be administered, with the view of removing the tympanitis, which is a source of much distress to the patient.

Management of Congested Intestine—The condition in which the contents of the sac are found in a case of hernia, determines greatly the course which the surgeon should pursue after the division of the stricture. Most frequently the intestine is deeply congested, being of a reddish purple, a claret, or chocolate colour. This congested state must not be confounded with gangrene of the part, which might happen if the surgeon were to content himself simply with judging of its condition by the colour. However dark this may be, the gut cannot be said to be gangrenous so long as it is polished and firm, free from putrescent odour, and without a greenish tinge. In cases in which there is much doubt as to whether its vitality continues or not, it has been proposed to scarify its surface lightly with the point of a lancet. If blood flow from the punctures, this may be taken as a proof of the continuance of the vitality of the part. Such a procedure as this, however, is certainly attended by some degree of danger, and can seldom be required.

When the intestine is merely congested, however deeply this may be, the rule is, that it should be returned into the cavity of the abdomen in the hope of its ultimately recovering itself. This it will generally do if it have not been too much handled after the sac has been opened ; but in some cases it will slough a few days after it has been reduced, and, the faeces being discharged through the wound, a fæcal fistula will be formed ; this may happen as late as the eighth or tenth day after the operation.

Management of Tightly Constricted Intestine.—When the intestine has

been very tightly nipped by a sharp-edged stricture, so that a deep sulcus or depression is left upon it, it seldom, I think, recovers itself, whether the whole of the coil of gut have been thus affected, or the constriction have been limited to a small portion of the diameter of the intestine. It is remarkable how very quickly changes which are incompatible with life may ensue in a portion of gut that has been very tightly strangulated. I have known a coil of intestine, that had been but eight hours strangulated before the operation was performed, so tightly constricted as not to regain its vitality after reduction (Fig. 390). In such cases, the patient usually



Fig. 390.—Gangrened Intestine from Strangulation.

recover its peristaltic action. The administration of purgatives, by further irritating it, will increase the risk of inflammation, and it will probably do much harm. The patient, of course, must be ~~kept~~ kept on the simplest and most unstimulating diet—indeed, he should only be given barley water and ice for the first day or two, and afterwards even coffee, but no solid food must be given till the bowels have acted, and the peritonitis has passed.

ACCIDENTS AND MODIFICATIONS OF THE OPERATION.—The nature having been thus described, we have next to consider in this article accidents attending it, or modifications which may be required, such as Peritonitis, the Management of the Intestine according to its position, the Management of Adhesions and of the Omentum, Wounds of the Intestine and of Arteries, Sloughing of the Sac, Artificial Anus, and Pilon Fistula.

Peritonitis after Operation.—The great danger to be apprehended after operations for hernia is the supervention of *peritonitis*. This may have existed before the operation, may be impending at the time, and may be occasioned, or at all events greatly increased by the necessary *wound of the peritoneum*. Two distinct kinds of *peritonitis* commonly follow operations for hernia, the active or acute, and the passive or latent.

Acute Peritonitis is commonly met with in strong and robust persons otherwise healthy, who are the subjects of the operation. It presents the ordinary symptoms of acute idiopathic inflammation of the abdomen: there is tenderness of a diffused character, with lancinating pains. The patient lies on his back, with his knees drawn up, has an anxious countenance, a quick, hard pulse, a dry tongue, and much inflammatory fever; the respiration is principally thoracic, and tympanitis soon comes on. The bowels are usually constipated, though sometimes irritated. The treatment of this form of herniary peritonitis is best conducted upon ordinary antiphlogistic principles; the disease is an active inflammatory one, and vigorous means must be taken to subdue it. This may be best done by free incision and the application, perhaps repeated, of two or three dozen leeches to the abdomen; calomel (gr. ij.) and opium (gr. $\frac{1}{2}$ or gr. j.) in pill must be administered every fourth or sixth hour, and the patient confined to barley-water and ice. As the inflammatory action is subdued, the constipation which is occasioned by it will be relieved without the necessity of administering any purgatives. The tympanitis may best be removed by turpentine enemata, and any lurking tenderness by the application of blisters.

Latent or Passive Peritonitis appears to be of the diffused or erysipelatous character. It chiefly occurs in old people, or in weakly subjects, and is especially apt to follow upon inflammation of the omentum and its consequent suppuration; or it may occur in consequence of the extension of diseased action from the cutaneous wound, and in other cases from the morbid action induced by the strangulated gut. In hospital patients especially all diseases tend to assume a low character, this inflammation is usually mild. In some instances, it sets in without any of the symptoms of inflammation, such as pain, tenderness, or swelling, and on the third or fourth day a quick, weak pulse, an anxious countenance, and a sinking strength. It is usually fatal, and is found to be the cause of death in a large number of cases.

ough; in many instances in such quantity as to give it a puriform appearance, and not unfrequently matting together the coils of intestine. In the treatment, it is necessary to support the patient, and in some instances even to administer stimulants, such as ammonia, the brandy and egg mixture, &c. Depleting measures of all kinds are quite inadmissible; and, indeed, the remedy that offers most prospect of benefit to the patient is opium, in full doses, one grain being given every third or fourth hour until some effect is produced upon the constitution. Opium not only acts as a useful stimulant in these cases, but has a tendency to allay the increased vascular action. At the same time, a blister to the abdomen, to be dressed with mercurial ointment, may be advantageously employed; and turpentine enemata may be administered, with the view of removing the tympanitis, which is a source of much distress to the patient.

Management of Congested Intestine.—The condition in which the contents of the sac are found in a case of hernia, determines greatly the course which the surgeon should pursue after the division of the stricture. Most frequently the intestine is deeply congested, being of a reddish purple, a claret, or chocolate colour. This congested state must not be confounded with gangrene of the part, which might happen if the surgeon were to content himself simply with judging of its condition by the colour. However dark this may be, the gut cannot be said to be gangrenous so long as it is polished and firm, free from putrescent odour, and without a greenish tinge. In cases in which there is much doubt as to whether its vitality continues or not, it has been proposed to scarify its surface lightly with the point of a lancet. If blood flow from the punctures, this may be taken as a proof of the continuance of the vitality of the part. Such a procedure as this, however, is certainly attended by some degree of danger, and can seldom be required.

When the intestine is merely congested, however deeply this may be, the rule is, that it should be returned into the cavity of the abdomen in the hope of its ultimately recovering itself. This it will generally do if it have not been too much handled after the sac has been opened; but in some cases it will slough a few days after it has been reduced, and, the faeces being discharged through the wound, a fecal fistula will be formed; this may happen as late as the eighth or tenth day after the operation.

Management of Tightly Constricted Intestine.—When the intestine has been very tightly nipped by a sharp-edged stricture, so that a deep sulcus or depression is left upon it, it seldom, I think, recovers itself, whether the whole of the coil of gut have been thus affected, or the constriction have been limited to a small portion of the diameter of the intestine. It is remarkable how very quickly changes incompatible with life may in a portion of gut that has been tightly strangled.

I have a coil of intestine, that had been but eight hours strangled before it was performed, so tightly constricted as not to regain its reduction (Fig. 390). In such cases, the patient usually



Fig 390.—Gangrenous Intestine from Strangulation

and firmly tying down the gut. On dissecting this carefully through the constricted portion of intestine subjacent to it sprang up to its full diameter, all constriction being removed, and was then very readily reduced.

Management of Omentum.—If the omentum be small in quantity, healthy in character though congested, and apparently recently protruded, not having undergone those changes that occur in it when it has been a long time in a hernial sac, it should be reduced after the intestine has been put back. If, however, its mass be very large, or if it be hypertrophied, indurated, or otherwise altered in structure, or if it be closely adherent to the sac, at the same time that it is congested, I think the best surgeons are agreed that it should not be returned into the abdominal cavity; as inflammation of it, *Epiplitis*, will probably set in and terminate fatally with effusion into the peritoneal sac. So also, if the omentum be in large quantity, and have become inflamed in the sac, it should not be returned, as the inflammation in it is very apt to run on to a kind of sloughy condition of the whole mass. If gangrenous, it should certainly not be reduced. In all these cases of hypertrophied, inflamed, or gangrenous omentum, the best practice consists in cutting off the mass, as recommended by Sir A. Cooper and Lawrence. If it be left in the sac, inflammation or sloughing of it may occur, and the patient can derive no corresponding advantage to the danger he will consequently run. Excision of the mass is usually practised by seizing and cutting it off at a level with the external ring. As the arteries of the stump, which are sometimes pretty numerous, are apt to bleed freely they must be tied singly by fine ligatures, which should be left hanging out of the wound. There is often a tendency to the retraction of the stump of the omentum into the abdominal cavity; in which case the ligatures dropping into the peritoneum, and acting as setons, may become sources of great irritation: in order to prevent this, the better plan is to knot them together, and to fix their ends by a piece of plaster upon the forepart of the abdomen. Surgeons formerly were in the habit of including the constricted neck of the omentum in a tight whipcord ligature, cutting off the mass below this, and leaving the stump in the inguinal canal or ring. This practice has been generally abandoned, from dread of peritonitis being induced by the constriction of the ligature. It may, however, be safely followed in some instances, in those particularly in which the protruded mass is very much indurated, having a narrow neck. I have of late years employed it with excellent effect, and indeed now generally prefer it to the method just described, over which it possesses the advantages of freedom from hemorrhage and impossibility of deep retraction of the cut edge of the omentum into the cavity of the abdomen, provided moderate traction be kept up in the ligatures. The constricted stump of omentum sloughs away in a few days, and separates with the ligatures. When this practice is adopted, the wound should not be closed, but must be lightly poulticed. The quantity of omentum that is cut off varies considerably; the mass removed usually weighs from four to six ounces, but in some instances it may amount to a pound or more.

Sacs or Apertures are occasionally formed in the omentum, in which a knuckle of intestine may become enveloped, or by the margins of which it may be strangulated. These envelopes of omentum around the gut, which have been especially described by P. Hewett, may occur in all kinds of hernia, at least in the inguinal, the femoral, and the umbilical, and sometimes acquire a large size, completely shutting in the gut. It is of importance to bear the possibility of their existence in mind, and in all cases to unravel

omentum before removing it, lest it contain a knuckle of intestine, which might be wounded in the operation.

Cysts, usually containing pellucid serous fluid, though sometimes filled with blood, are occasionally met with in the omentum. They are globular, elastic, and closely resemble in form a knuckle of intestine, occasioning not a little embarrassment to the surgeon: by a careful examination and travelling, however, of the omentum, their true nature will be made out; their fluid contents may then be discharged, and the omentum dealt with according to the rules already given.

Wounds of the Intestine may accidentally occur at two periods of the operation; either from the surgeon cutting too freely down upon the sac, and opening this before he is aware of what he is about; or else, at the time of the division of the stricture, from a portion of the gut which lies beneath it, getting into the way of the edge of the knife, and being nicked by it. The first kind of accident can only happen from a certain degree of carelessness; but it is not always so easy to avoid wounding the gut, when the stricture is so tight that the finger-nail cannot be slipped under it as a guide to the hernia-knife. In cases of this kind, a very narrow director must be used; and this is a most dangerous instrument, as, in passing it deeply out of sight under the tight stricture, a small portion of the gut may curl up over its side into the groove, and thus become notched by the knife as this is slid along it. This accident has happened to the best and most careful surgeons. Lawrence relates two cases that occurred to him; and Sir A. Cooper, Cloquet, Jobert, and Liston have all met with it. It may be known to have occurred by the bubbling up of a small quantity of flatus and liquid feces from the bottom of the incision. The *Treatment* of a wound of the gut must depend upon its size. When it is very small, rather resembling a puncture than a cut, the practice recommended by Sir A. Cooper should be adopted; viz., to seize the margins of the incision with a pair of forceps, and to tie a fine silk thread tightly round them, the ends of which should then be cut off, and the gut returned into the abdominal cavity. Such a proceeding as this does not appear to give rise to much, if to any, increase of danger. In a case that occurred to me at the Hospital, in which, owing to the excessive tightness of the stricture, a very narrow director only could be passed under it, the gut immediately above it was notched and opened by a kind of punctured wound; this was tied up in the way mentioned, and, after the death of the patient, which took place on the fourth day after the operation from gangrene of the strangulated portion of bowel, the silk ligature was found to be completely enveloped in a plug of plastic matter. If the wound be of larger size, it must be closed by the glower's stitch.

Wound of one of the Arteries in the neighbourhood of the sac may occur during the division of the stricture, either in consequence of some anomaly in the distribution of the vessel, or from the surgeon dividing the parts in a wrong direction. This accident usually happens to the epigastric or obturator arteries; and Lawrence has collected fourteen recorded cases in which it has occurred. The result in these has been very various; in some the patients have died; in others, after much loss of blood, and consequent faintness, the bleeding ceased spontaneously. The proper *Treatment* would certainly consist in cutting down upon and securing the bleeding vessel. In the event of the surgeon operating on a case of hernia, without having been able previously to satisfy himself as to its precise character, or if from any cause, in dividing the stricture, he have reason to dread the proximity of an artery, he may safely and readily divide the constriction with a knife

that would not easily cut an artery ; and had of his hernia-knife by drawing it over the still be keen enough to relieve the strangled it any artery that may happen to be in the v

Sloughing of the Sac is of rare occurrence, mostly attended by fatal results ; it is not, I twice happened in my practice ; and in both an old woman on whom I operated for femoral sac sloughed away, exposing nearly the whole as much distinctness as if it had been diseased danger for a time from an acute attack recovered.

Artificial Anus and Fæcal Fistula — When the bowel by which the whole of the intestinal condition is denominated an *artificial anus*, escapes, the greater part finding its way through a fistula is said to exist. The quantity of depends upon the extent of destruction of character on the part of the gut that is injured involuntarily, and is usually continuous.

This condition may occur in several ways. It may be accidentally wounded during the operation, and continue to be discharged through the aperture. It may have been gangrenous, and have given way into the peritoneum, the surgeon may have intentionally laid open the gut, so as to facilitate the escape of the feces. The bowel has been severely nipped, and is dark, but not actually fallen into a state of gangrene. It may itself after its return into the abdominal cavity, in the course of three, four, six, or even ten days, become gangrenous, a small quantity of feculent matter is discharged, and gradually a greater discharge appears, until a completely established. In such cases, it is usually the case, although the bowel gives way within the peritoneum, but escape of feces become extravasated into this, but escape of feces. The circumstance is owing to the fact of the peritoneum losing its peristaltic action, and consequently the parts in the neighbourhood inflaming, the parts being consolidated to each other and to the peritoneum, the gangrenous portion of the gut, and consequently of great importance, in cases of this kind, to disturb the adhesions that have formed between the gut and the neck of the sac.

The *Pathology of Artificial Anus* is connected with the aperture in the gut are glued by plastic matter, and, whether the whole or a portion only of the gut is destroyed, the apertures of the upper and lower gut almost in a continuous line, soon unite at the neck. These are at first similar in size, and present a similar shape or appearance : as the disease becomes more extensive, the transmission of feces, gradually becomes narrowed, it may be almost completely obliterated, while the upper becomes dilated (Fig. 392 a), in consequence

light obstruction to the outward passage of the fæces. The mesenteric portion, opposite the aperture, becomes drawn out into a kind of prolongation or spur, the full importance of which was first pointed out by Dupuytren. This spur-like process projects between the two apertures, and, being deflected by the passage of the fæces, has at last a tendency to act as a kind of valve, and thus to occlude the orifices into the lower portion of the gut. The integuments in the neighbourhood of such an aperture as this usually become irritated, inflamed, and excoriated, from the constant passage of the fæces over them. In some cases, the mucous membrane lining the edges becomes everted, and pouting; and, in others, a true prolapse takes place, large portions of the membrane protruding. An artificial anus fully formed in this way never undergoes spontaneous cure. Besides this, which is the ordinary form of artificial anus, we must, I think, recognise at least two other varieties, both of which I have met in practice. In one of these, the angle formed by the gut is adherent to the upper extremity of the sac which has been returned, and thus lies at some distance from the surface, so that the fæcal matter traverses a long canal before it reaches the external aperture. In the other variety the angle of the gut is fixed at a higher point within the abdomen, and the fæces find their way out through a channel bounded by agglutinated coils of intestine and layers of lymph. In both of these forms, there is a considerable distance between the external opening and the aperture in the gut. Thus, then, there are three forms of artificial anus, differing from one another according to the situation of the angle of the gut in relation to the external opening and to its connections.

When a *Fæcal Fistula* has formed, the condition of parts is somewhat different. The aperture in the intestine consists of merely a small perforation in its coats, unattended by any considerable loss of substance, through which a quantity of thin fluid and feculent matter exudes, giving rise to a good deal of irritation of neighbouring structures. In some cases, there are several apertures communicating with the gut, and extending through the skin. Fistulous openings of this kind not unfrequently undergo spontaneous cure after existing for a few weeks or months.

Treatment.—If the aperture be merely a small one, with a narrow fistula leading into the gut, the chief inconvenience suffered by the patient often arises from the irritation of the skin around the opening by the continued moisture of the feculent matter. In such cases the skin should be protected by means of zinc ointment, spread on lint; and the patient should wear a pad to restrain the discharge. By the pressure of this pad the aperture may sometimes be made to close. In other cases, the occasional application of the galvanic cantery or of a red hot wire will induce contraction of its edges; and in other instances, again, a plastic operation of some kind may be required. But I confess I have not usually seen much advantage result from such operations, which are often followed by erysipelas. As the existence of an artificial anus, by interfering with nutrition, commonly gives rise to considerable emaciation, it becomes necessary to support the patient's strength by a sufficient quantity of good and nourishing food; thus is of greater consequence the higher the fistula is, as the interference with the earlier stages of the digestive process, and the loss of nutritive material by the discharge of the chyme, is proportionally great. Spontaneous cure will occasionally take place, even though a perfect artificial anus exist. In a case under my care at the Hospital, a whole knuckle of intestine was gangrenous, and sloughed away, leaving an artificial anus, which discharged the greater part of the intestinal contents, but gradually

contracted and closed without any local attention to cleanliness.

If the aperture become a permanent artificial anus, if possible, be adopted in order to effect a cure. The important indications have to be fulfilled. In the projecting valvular or spur-like process the continuity of the canal; and, after this has been secured, the anus may be closed, by paring its edges, and bringing the lips together.

The first object is best accomplished by (Fig. 91); this consists of an instrument somewhat like a pair of blunt but serrated blades, which may be brought together by a screw that traverses its handle. One blade



Fig. 91. Deviser's instrument.
Blunt blades.

into the upper, the other (b) into the lower part of the intestine, and then approximated slowly, and fixed by means of a screw. To compress on each side the spur-like process of the intestine, day by day, this screw is tightened so as to bring the edges of the blades into contact, and cohesion of its serous surfaces. Attention caused by the instrument will occasion the formation of a fistula in the angle formed by the intestine, so that the anus may become consolidated, and all opening into the intestine. Should the spur-like process be accidentally torn out in sufficient quantity, the patient's death would probably ensue; hence the necessity of great caution. So soon as the blades of the instrument have been removed, the spur-like process has consequently sloughed off, and the closure of the artificial anus will be removed. The canal being thus re-established, its lips may be brought together by hare-lip pins and sutures. In some cases

has elapsed—many years, possibly—the fistula continues permanently patent, and no treatment is available for its erasure. Its existence is not incompatible with good general health. I have at present two cases under my constant observation, in one of which the whole of the intestinal contents have been discharged for four years through an aperture of the umbilicus, in a woman about 50 years of age, consequent on the sloughing away of a large coil of intestine in an umbilical hernia; and another case is a lady of 80, who has for upwards of thirty years had a faecal fistula in the right groin, consequent on an operation for femoral hernia.

OPERATION WITHOUT OPENING THE SAC.—The possibility of removing the stricture in strangulated hernia without laying the sac open, naturally suggested itself when it was known that in many cases the stricture was seated in the tendinous and cellular tissues outside the neck of the sac, and that, when these were divided, the protrusion was readily reduced. This operation was performed by Petit as long ago as 1718, but was seldom practised until it was revived of late years by Aston Key and Luke. The great advantage sought to be gained by this operation is that, as the peritoneum is not interfered with nor its cavity opened, the risk from peritonitis will be proportionately lessened. The wound made by the operation being altogether superficial, and the sac not opened, its risk has been compared to that of the taxis, with the addition of that which would result from a superficial wound. This argument would be conclusive in favour of the operation without opening the sac, if it could be shown that, in all cases of strangulated hernia, peritonitis is occasioned by interfering with the peritoneal cavity; it must, however, be admitted, even by the keenest advocates of Petit's operation, that this is not the case. In many instances the inflammation exists before any operation is performed, being evidently produced by the stricture of and consequent injury to the gut. But it cannot with fairness be argued that, though the peritonitis may exist before the operation, the incision of the peritoneal cavity does not increase it; even in healthy persons, laying open the abdomen, handling the gut and omentum, and pushing the fingers into the peritoneal sac, would always be followed by intense, often by fatal, peritonitis. It is only reasonable to believe that the same procedures in an already inflamed peritoneum would be followed by equally disastrous results.

That the opening made into the cavity of the abdomen in reality adds to the frequency of the peritonitis, cannot, I think, be doubted by any surgeon. It not unfrequently happens in strangulated hernia, that no sign of peritoneal inflammation sets in until one or two days after the operation is performed; and then it occurs evidently as the result of this procedure. That the fatality of the peritonitis, even if existing before any operation be practised, must be greatly increased by interference with the serous sac, is evident from the fact already mentioned, that death very rarely occurs (not more than once in many hundred cases) after the reduction of a strangulated hernia by the taxis. Fully admitting, therefore, that in many cases the peritonitis exists before the operation, and is occasioned by causes independent of it; it is, I think, impossible to deny that the inflammation is frequently directly occasioned by opening the peritoneal cavity, and handling the viscera; and that, when already existing, its fatality must be greatly increased by this procedure. In fact, there are two causes for peritonitis in cases of operated strangulated hernia—viz., the constriction of the stricture, and the wound of the peritoneum. That peritonitis which arises from the pressure of the stricture is equally liable to happen, whether Petit's operation or that by opening the sac be practised, and often precedes the operation; whilst the peritonitis which arises from wound of the serous membrane does

not occur in Petit's operation, but is necessary when the sac is opened.

There are, however, two objections that operation with more justice than that it does
rence of peritonitis. The first is, that if the
sometimes be returned in a gangrenous con-
the gut may possibly be returned still stran-
by incision in an omental aperture. With
it may be stated that, if the intestine be in-
usually be some evidence of this, either in t
in the general symptoms of the patient, or in
coverings, which will enable the surgeon to
enclosed parts, and will of course induce
examine them thoroughly. This objection,
cases in which the strangulation has only a
insufficient to allow of the occurrence of ga-
oppose the performance of Petit's operation is
With regard to the occurrence of internal stran-
and when it does occur, it still more rarely may
be effected by bands of adhesion or by un-
the parts can be returned without opening the
also between this structure and its contents.
objections against the operation without open-
have followed this practice. Luke, who has
subject, states that he has operated in 84 ca-
the sac was opened; in 59 the sac remained un-
it was opened, 8 died; whilst of the 59 in w
formed, only 7 died. If to Luke's cases
Ward, we shall find 36 deaths in 163 cases
the ordinary operation, indeed, of openin
fatal one, is well known to all hospital su-
surgical statistics. Of 77 operations for hern
36 proved fatal, and of 545 cases recorded in
Dr. Turner, 260 are reported to have died.
operations is most favourable, when contrasted
was opened.

The operation without opening the sac may be performed in some cases, but is much more readily done in some than in others. It is especially applicable in cases where the stricture is commonly outside the sac, as will be seen in that form of the disease. Of 31 cases of this kind, Luke, the sac required to be opened in 7 cases, and it was not so easy to perform Petit's operation; in 24 cases the surgeon will fail to remove the stricture, the constriction being usually seated in the neck of the observable in congenital hernia. Of 20 cases of this kind, Luke, the sac required to be opened in 13 cases.

For the various reasons that have been in opinion that this operation should always be an ordinary one of opening the sac, in those cases having been long strangulated, presents no sign in it, and more especially when it is femoral or inguinal, in completing Petit's operation, in consequence of the stricture in the neck of the sac, or the constriction of the intestine.

have resulted; for the sac, after being exposed, may at any time be opened in the ordinary way, and the operation completed by dividing the stricture from within.

When the hernia is of large size and irreducible, it is of especial importance to avoid opening the sac. If it be opened, the contents will inflame, and fatal peritonitis commonly ensues. In these cases, as Luke has pointed out, it rarely happens that the old adherent parts are seriously strangled, but the whole mischief seems to be occasioned and to be received by the new protrusion that has taken place, and that gives rise to the tension; and if this can be liberated and reduced, the surgeon has done all that need be accomplished. The evidence of the reduction of the recent protrusion, although the old adherent and irreducible hernia be left is usually sufficiently obvious; the portion of gut returning with a slip and a gurgle, with considerable diminution in the general tension of the tumour.

Operation.—With regard to the mode of performing Petit's operation, little need be said here, as it is precisely identical with the steps of the other operation up to the period of the exposure of the sac; except that, when it is not intended to open this, the incisions should be carried more directly over its neck. The stricture, if situated outside the sac, will then be found either in some of the tendinous structures surrounding it, or else in the subserous cellular tissue lying upon it. After the division of the constricting bands in this situation, by means of a probe-pointed knife carried underneath them, or by dissecting down upon them, an attempt at the taxis may be made by compressing the tumour in the usual way, at the same time that its neck is steadied by the fingers of the left hand. If the contents can be reduced, the incision in the superficial structures is brought together by a few strips of plaster, over which a pad and bandage may be applied. Should peritonitis come on, as the result of the strangulation, it must be treated in the usual way. If, after the surgeon has fairly divided all the structures outside the sac, he find still that the return of the hernia is prevented by some constriction in its neck, it will be necessary to lay this open and divide the constriction in the usual way.

REDUCTION IN MASS.—The reduction of the hernia in mass consists in the return of the sac and its contents into the abdomen still in a state of strangulation. When it is said that the parts are returned into the abdomen, it must not be understood that they are pushed back into its cavity, but that the external protrusion is caused to disappear by being pushed into the subserous cellular tissue behind and underneath the parietal peritoneum, between it and the abdominal muscles. This remarkable accident, which was first described by the French surgeons of the last century, received but little notice from practitioners in this country until attention was drawn to it by Luke, by whom its pathology has been carefully studied. Birckett, who has investigated this condition with much care, is of opinion that the sac is not torn from its connections in the scrotum or canal, and pushed back, but that it is ruptured, usually at its posterior part at its neck, and that thus the contents of the sac are forced through this rent into the subperitoneal cellular tissue; whilst the mouth of the sac, still constricting the hernia, and thus keeping it in a state of strangulation, is pushed back from the internal ring. It appears to me that both explanations are correct, and that we must admit two forms of reduction in mass; the sac being pushed back intact in a state of strangulation, in one form as described by Luke; whilst in the other, as observed by Birckett, the sac is ruptured, and the hernia, strangulated by the displaced mouth of the sac, is forced out through the rent.

Cause.—The reduction in mass has been observed only in inguinal hernia and has chiefly occurred from the patient's own efforts in reducing a strangulated rupture. It is a remarkable fact that, in most of the instances in which it has occurred, only a very slight degree of force appears to have been employed in the reduction of the tumour; and the accident would seem to have resulted from the adhesions between the sac and the neighbouring parts being much weaker than natural, so that a moderate degree of force caused the whole to slip through the canal. It may, however, occur from the surgeon's efforts, if these be too forcible or long continued.

Symptoms.—The symptoms indicative of this accident are constitutional and local. The constitutional symptoms consist in a continuance of those that are indicative of the existence of strangulation, notwithstanding the disappearance of the tumour. The vomiting and constipation persisting, the patient speedily becomes much depressed in strength, being seized with hiccup and prostration of all vital power, signs of gangrene then evince themselves within the sac; and death ensues.

An examination of the parts in hernia will usually enable the surgeon to recognise the nature of the accident; he will ascertain that a tumour has previously existed, and will learn from a description of its general character and the symptoms occasioned by it, that it was in all probability a strangulated rupture. He will then find, on examining the part, that there is a total absence of all that fulness which is occasioned by the presence of the sac, even after its contents only have been reduced; the sac, in such cases, always giving rise to a feeling of fulness and roundness in the part. He will, on the contrary, find that the abdominal ring is peculiarly and very distinctly opened; it is much larger than usual, and somewhat rounded. On pushing the finger into the canal, this will be felt quite empty; but in some cases, on deep pressure with the finger, especially when the patient stands or coughs, a rounded tumour may be indistinctly felt behind the ordinary seat of the hernia. In many cases, however, the most careful manual examination will fail to detect any prominence of this kind.

Treatment.—If, after careful examination of such a case as this, in which the symptoms of strangulation continue, the surgeon learn by the previous history that a tumour has existed, but that it has suddenly gone up, and further, if he find that the seat of the supposed hernia presents the negative evidence that has just been described, it will then be necessary for him to push his inquiries a step further by an exploratory incision. Such an incision as this may first be used as a simple means of diagnosis, and, if it does not penetrate the peritoneal cavity, there is no danger attending it; and if the hernia be found, it will serve the purpose of the ordinary incision required in the operation, and may be used for the relief of the strangulation. The first incision should be made so as to expose the abdominal ring; if this be found peculiarly round and open, it would increase the probability of the existence of the condition sought for. The inguinal canal must next be laid open, and the parts contained within it carefully examined. If no appearance of hernial sac be found, but the cord be distinct and clearly seen, still further presumptive evidence will be afforded of the accident having been effected in mass; for, if the hernia have been reduced in the usual way, the sac will necessarily be left in the canal, and will preserve its usual relations to the cord. This supposition will be strengthened almost to a certainty if it be found that the "condensed cellular capsule immediately investing the sac," as it is termed by Luke—in other words, the condensed and laminated subserous cellular tissue—has been left in the canal. An opening made into this will, as that surgeon observes, allow

finger to be brought into contact with the hernial tumour itself. Should, however, this condensed cellular tissue not be found, it must not be concluded that no hernia is present, inasmuch as this investment may have been accidentally absent. The finger should then be passed into the internal ring, which will probably be found open, and should be carried from side to side; the tumour, if present, will be detected lying externally to the peritoneum behind the abdominal wall. When found, it must be brought down into the canal by enlarging the ring; it must then be opened, its contents examined, and the stricture in its neck divided. The intestine that has been so strangled must be dealt with in accordance with the rules already laid down. If the tumour cannot be readily brought down so as to admit of an examination of it and its contents, the patient should be desired to make some propulsive efforts, so as to cause it to protrude. If it still do not come down, it must be opened, and the stricture cautiously divided within the abdomen with a sheathed bistoury.

HYDROCELE OF THE HERNIAL SAC is a rare condition, the pathology of which has already been adverted to. In the *Treatment*, two lines of practice are open, the palliative and the curative. The first consists in merely tapping, and thus withdrawing the fluid; and the other, in freely laying open the lower portion of the sac, and endeavouring to secure its closure by granulation. This operation, which, however, is not devoid of danger, has been performed with success by Pott and others.

CHAPTER LXII.

SPECIAL HERNIE.

INGUINAL HERNIA.

By *Inguinal Hernia* is meant that protrusion which occupies the whole or a portion of the inguinal canal, and, when fully formed, passes out of the external abdominal ring into the scrotum. Many varieties of this hernia are recognised by surgeons. Thus it is said to be *Complete*, when it passes out of the external ring, *Incomplete*, or *Interstitial*, so long as it is contained within the canal; *Oblique*, when it occupies the whole course of the canal; *Direct*, when it passes forwards through a limited extent of it; *Congenital*, when it lies in the sac of the tunica vaginalis; and *Encysted*, or *Infantile*, when it lies behind this. Inguinal hernie constitute the commonest species of rupture, and would be much more frequent than they are, were it not for the obliquity of the canal, and the manner in which its sides are applied to one another, and closely overlap the spermatic cord. They occur with most readiness in those cases in which the canal is short and the apertures wide. Although these hernie are commonly incomplete in their early stages, it is seldom that they come under the observation of the surgeon until the protrusion has passed beyond the external abdominal ring.

Oblique INGUINAL HERNIA, often called *External*, on account of its relation to the epigastric artery, passes through the whole length of the canal, from one ring to the other; and usually protrudes through the external one, constituting one of the forms of *Scrotal Hernia*.

Coverings.—As it passes along the canal, it necessarily receives the same investments that the spermatic cord does; although these are often greatly modified by being elongated, hypertrophied, and otherwise altered in appear-

ance. If we regard the inguinal canal as consisting of a series of invaginations of the different layers of the abdominal parietes, the outermost being the skin, and the innermost the fascia transversalis, with the peritoneum applied to this, it is easy to understand how the hernia in its descent through these prolongations drawn over it, thus becoming successively invested with the same coverings as the spermatic cord. Thus it first pushes before that portion of the peritoneum which lies in a fossa just external to the epigastric vessels; it next receives an investment from the fascia transversalis, which often becomes thickened and laminated, constituting the *fascia propria* of the sac; as it passes under the internal oblique, it receives some of the fibres of this muscle, in the shape of the cremasteric fascia; and, lastly, when it reaches the external abdominal ring, which it greatly distends and renders round and open, it becomes covered by the intercolumar fascia, receiving also a partial investment around its neck from some of the expanded and thickened fibrous bands that lie near the ring, and which are always most marked upon its outer side.

Relations.—The relations of the spermatic cord and testes, and of the epigastric artery, to an inguinal hernia, are of great importance. The spermatic cord will almost invariably be found to be situated behind or rather underneath the oblique inguinal hernia; and the testis will be found to lie at its lower and back part, where it may always be distinctly felt. In some cases the elements of the spermatic cord become separated, the vas deferens lying on one side, and the spermatic vessels on the other. In other rare cases, as an instance of which there is in a preparation in the University College Museum, the hernia lies behind the cord, and has the testis in front. In other cases, again, it may happen that the elements of the cord are all separately spread out on the forepart of the hernial tumour. The epigastric artery has the same relations to the oblique inguinal hernia that it has to the spermatic cord, lying to the inner side of and behind its neck. The pressure of large and old inguinal herniæ has, however, a tendency to modify somewhat the relations of this vessel. By distending the rings, and dragging the posterior wall of the canal downwards and inwards, they shorten the canal, and cause a great deflection of the artery from its natural course, which is changed from an oblique direction to one curved downwards and inwards, under the outer edge of the rectus muscle.

DIRECT INGUINAL HERNIA.—This does not pass out like the oblique through the internal abdominal ring, but pushes forward through a triangular space, which is bounded by the epigastric artery on the outer side, the edge of the rectus on the inner, and the crural arch at its base, through this the hernial tumour protrudes, pushing before it or rupturing the posterior wall of the inguinal canal.

Coverings.—These vary according to the length of the canal that the hernia traverses, and the portion of the posterior wall through which it protrudes. In fact, there are at least two distinct forms of direct inguinal hernia, which differ according as they are situated above or below the remains of the umbilical artery. One, the most common variety, is situated below the cord-like remains of this vessel, between it and the outer edge of the rectus. The other, which is of less frequent occurrence, is situated above this vessel between it and the epigastric artery.

In that form of direct inguinal hernia, which lies below the umbilical artery, the protrusion takes place through that part of the posterior wall of the inguinal canal which is situated almost behind and opposite to the external ring. In this situation, the investments successively received by the hernia are, first, the peritoneum and the fascia transversalis; it then

comes into contact with the conjoined tendons of the internal oblique and transversalis muscles, which it may either rupture or push before it, thinned out and expanded. Most frequently these are ruptured, constituting a partial investment to the protrusion, which is most evident on the innermost part of the sac, that which is nearest the mesial line. As the hernia passes through the external abdominal ring, it receives from it the inter-columnar fascia and fibres, and lastly is invested by the common fascia and integuments.

In the direct inguinal hernia which lies above the umbilical artery, which is of rare occurrence, the protrusion may pass under the lower edge of the transversalis muscle, and then receives a partial investment of cremasteric fascia, especially on its iliac side, as it comes into relation with the internal oblique. This form of direct inguinal hernia, therefore, receives very nearly the same covering that the oblique does, though its investment by the cremaster is not so perfect. It does not come into relation with the conjoined tendons.

Relations.—In the direct inguinal hernia, the spermatic cord lies to the outer side of the sac; and its elements are never separated from one another, as occasionally happens in the oblique. The epigastric artery also is on the outer side, but usually arches very distinctly over the neck of the sac, sometimes indeed completely encircling the upper as well as the outer margin (Fig. 393).

INCOMPLETE OR INTERSTITIAL HERNIA is usually of the oblique kind; but Lawrence has observed that it may be of the direct variety. It often escapes notice, but may not unfrequently be observed on the opposite side to an ordinary inguinal hernia.

DOUBLE INGUINAL HERNIA, on opposite sides, are of very common occurrence, and they may be of the same, or assume different forms. In some instances, the two forms may be observed on the same side (Fig. 394).

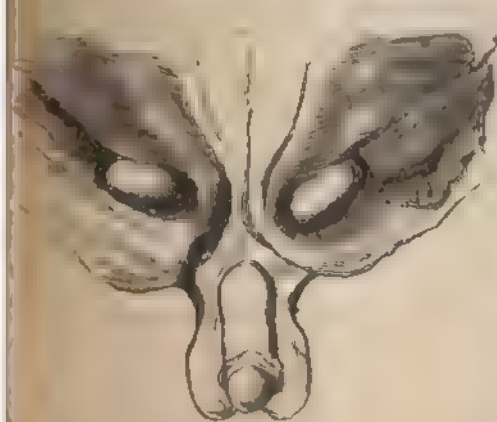


Fig. 393.—Double Direct Inguinal Hernia: Neck of Sac crossed by Epigastric Artery

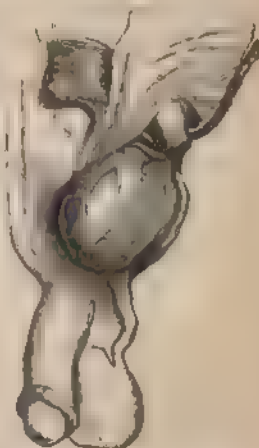


Fig. 394.—Double Inguinal Hernia on the same side. The upper sac, etc. etc. separated by epigastric vessels

In females, inguinal hernie are not very common, except at advanced periods of life; they will then be seen to have the same relations as in the male, except that the round ligament is substituted for the spermatic cord.

The obturator artery, when arising in the normal manner from the iliac, does not come into relation with the neck of the sac; but when it takes its origin, as it not unfrequently does, from the external or common femoral, or the epigastric, it may have important relations to part of the hernia. Most commonly, under these circumstances, it is to the iliac or outer side of the neck, but occasionally it winds round the inner or pubic side, coming into rather close relation with it, and this will immediately be mentioned, it may be in considerable danger during operation. The combination, however, of this particular variety of obturator artery and femoral hernia, is uncommon, because, in the first, this internal division of the artery is rare, when it does occur, it passes directly over the portion of the crura through which it would protrude, and is thereby strengthened, and so diminishes the chance of rupture.



Fig 399.—1, Femoral Hernia, 2, Femoral Vein, 3, Femoral Artery, giving off, 4, Common Trunk of Epigastric and Obturator Arteries, and 5, Epigastric Artery, 6, Spermatic Cord.

Contents. The contents of a femoral hernia are usually intestine, most commonly a portion of the small intestine. Occasionally omentum is contained within, but seldom in large quantity. I have, several times had occasion to operate in cases of old femoral hernia, when it became necessary to remove large portions of adherent omentum; ten and a half ounces, and in the other, about seven. In each case was a small knuckle of intestine strangulated behind the omentum. Ovaries, Fallopian tubes, &c., have been known to be strangulated in a variety of hernia.

Symptoms.—The symptoms of femoral hernia are usually well marked. They consist of a tolerably firm, tense, and unyielding tumour, of a pear shape, situated in the groin, to the inner side of the femoral vessels, having its neck under Poupart's ligament, though, as it increases in size, it may be turned above this structure; sometimes, though rarely, it passes upwards upon the thigh. Its size varies considerably; most commonly it is larger than a walnut or a pigeon's egg, and then is deeply seated at an angle between the body of the pubes and the femoral vessels, but occasionally it may attain a considerable bulk, as large as the fist or a small roll. When large, this hernia usually rises up above Poupart's ligament and extends outwards in a direction parallel to it, so that it assumes an elongated shape; it is then usually somewhat doughy and soft, even when strangulated; very different from the excessively tense feel that it has when small.

In some rare cases the femoral hernia has been found lying external to the vessels, the mouth of the sac being between them and the iliac vessels. In these cases the hernia is usually small, and the contents are usually intestine, but occasionally it may contain a large portion of the small intestine, and in some cases it may contain a large portion of the large intestine. In these cases the hernia is usually small, and the contents are usually intestine, but occasionally it may contain a large portion of the small intestine, and in some cases it may contain a large portion of the large intestine.

In some rare cases the femoral hernia has been found lying external to the vessels, the mouth of the sac being between them and the iliac vessels. In these cases the hernia is usually small, and the contents are usually intestine, but occasionally it may contain a large portion of the small intestine, and in some cases it may contain a large portion of the large intestine.

may be distinguished from hernia by being always of the same size, by not being reducible into the cavity of the abdomen, by the absence of all gurgle, and by its very defined outline. In the *diffused hydrocele* of the cord, the absence of distinct impulse on coughing, the impossibility of returning the swelling completely within the abdominal cavity, and of feeling the cord in a free and natural state, will prevent the disease from being confounded with hernia. *c. Hematocele of the Cord.* Here the soft and fluctuating nature of the swelling, the ecchymosis, the impossibility of complete reduction, and the absence of gurgling, will indicate its true nature. *d. Fatty or other Tumours* occasionally form on the cord; but the circumscribed character and limited size of these swellings, the absence of impulse on coughing, and of reducibility into the cavity of the abdomen, will point out that they are not hernia. *e. Lodgment of the Testis in the Inguinal Canal* will give rise to a tumour, which closely resembles incomplete inguinal hernia, and if it should happen to become inflamed in this situation, the difficulty of the diagnosis from strangulated hernia may be very considerable. In the ordinary undescended testis, the absence of that organ in the scrotum on the affected side, the peculiar sickening pain occasioned by the pressure of the tumour, the absence of gurgling, and of all possibility of reduction, will enable the diagnosis to be effected. *f. Inflamed undescended Testis.* From this it is not always at once easy to effect the diagnosis of incomplete inguinal hernia in a state of strangulation, with which, indeed, it may be complicated. This diagnostic point will be more fully treated of in speaking of congenital hernia. In the meanwhile it may be stated that the absence of *persistent and continuous* vomiting and constipation, the feel of the tumour, hard below, elastic above, and the peculiar pain when it is compressed, will enable the surgeon to recognise the true nature of the tumour as being a retained and inflamed testis.

2. When the hernia has descended *into the scrotum*, it may be confounded with—*a. Hydrocele of the Tunica Vaginalis.* In this disease there is an oval or pyriform tumour, usually translucent, unchangeable in size or shape by pressure, and having the cord clear and distinct above it, with an absence of impulse on coughing, or of gurgling in attempts at reduction. In cases of congenital hydrocele in children, in which there is still an opening communicating with the peritoneal cavity, the tumour may be diminished in size by steady pressure, but gradually returns again, fluctuates, and is translucent. In these cases its translucency, and the gradual manner in which the sac is emptied and is refilled, so different from the sudden slip up and protrusion of a hernia, enable the surgeon to establish the diagnosis. It not unfrequently happens that *hernia is complicated with hydrocele of the tunica vaginalis.* In these cases the two separate tumours can usually be distinguished, there being some degree of constriction, or of consolidation, between them. The hydrocele will present its ordinary characters of translucency, irreducibility, and circumscribed outline, and is commonly placed anterior to the hernia, which lies towards the back of the scrotum, and may be distinguished by its reducibility and impulse on coughing. It sometimes happens, as in a case which once fell under my observation, that a *hydrocele of the cord is associated with one of the tunica vaginalis and a hernia*; under such circumstances, the diagnosis requires a little care, but may be effected readily enough by separately determining the characters of the different swellings. *b. Varicocele.* Here the diagnosis may be effected in the way pointed out by Sir A. Cooper. The patient should be placed in the recumbent position, and the swelling reduced; the surgeon then presses upon the *external ring with his fingers*, taking care to cover the whole of it, and

finger-nail under it, and cautiously sliding the hernia-knife along this. It is an established rule in surgery, that this division should be effected in a direction immediately upwards, so that it may be parallel with the epigastric vessels, whether it be situated upon the inner or outer side of these. It is true that, if the surgeon could be sure that he had to do with an oblique inguinal hernia, he might safely divide the stricture outwards; or, if he were certain that the protrusion was of the direct kind, he might make the section inwards; but, as it commonly happens that he cannot determine with absolute certainty upon which hernia he is operating, he adopts the safer plan recommended by Sir A. Cooper and Lawrence, of cutting upwards from the middle of the ring parallel to the epigastric vessels.

The seat of stricture in inguinal hernia will thus be seen to differ in different cases; and in some instances it exists in two situations. I think it most commonly occurs in the neck of the sac, owing to contraction and elongation of it, with condensation of the subserous cellular tissue lying immediately upon it. In other cases, though much more rarely, it seems to be formed by a thickening of the transversalis fascia at the inner ring, but altogether outside the sac; occasionally it is met with in some part of the canal, at the lower edge of the internal oblique, but much more frequently at the external abdominal ring. In many cases there is very tight constriction in this situation, as well as in the deeper portions of the canal, or at the inner ring; hence, after the division of any stricture at the external abdominal ring, the deeper portions of the canal should always be carefully examined before any attempt is made to put the hernia back.

The operation for an *Incomplete Inguinal Hernia* requires to be conducted in the same way as that which has just been described, except that the incision need not be quite so long, and should not extend beyond the external ring. After this has been laid open, and the tendon of the external oblique shut up, a flat director must be passed under the lower edge of the internal oblique and transversalis muscles, which must be carefully divided; should the stricture not be relieved in this way, and the sac require to be laid open, the deep section must be made in the same way and in the same direction as has already been described.

In *Inguinal Herniæ*, containing either the *Cæcum*, the *Sigmoid Flexure of the Colon*, or the *Urinary Bladder*, the protruded viscera are only partially covered by peritoneum; hence, in operating upon such herniæ, when strangulated, care must be taken that the intestine be not wounded, which is apt to occur if the surgeon divide the parts without due caution, not suspecting himself to have reached the neighbourhood of the gut, but believing that he has met with a sac which does not exist. As the protruded parts are generally adherent in these cases, the surgeon must content himself with leaving them unreduced after the division of the stricture; under such circumstances, it has happened that the protrusion is ultimately drawn back into the abdomen by some natural action of the parts.

Operations for strangulated inguinal hernia are required during a greater range of ages than those for any other kind of protrusion. I have operated successfully for congenital hernia in infants less than six weeks old, and for an ordinary oblique inguinal hernia in one four months of age; and the operation has been done on centenarians. When small and recent, the protrusion usually consists of intestine only; when large, it commonly contains omentum as well. The treatment of these contents, and the after-management of the case, must be conducted in accordance with the rules laid down at pages 1189 et seq.

HERNIA IN THE TUNICA VAGINALIS: In case the hernia descends inside the tunica sac. It is always oblique, and takes the commonly descending into the scrotum, but canal, out of which, perhaps, the testis has differs from an ordinary oblique hernia in the sac, and in the protruded parts lying in the



Fig. 39. A congenital Hernia.

with the testicle (Fig. indeed, of this hernia along the canal left of It is well known that nally lies below the the later months of fo and scrotum, it pushes the peritoneum, exact

That prolongation tried down around the divided into two parts testicular. The funic to the cord, extend the scrotum; the tun the tunica vaginalis.

in consequence of the funicular prolongation normal condition, converted into a filament remaining pervious, and thus serving as between the general cavity of the peritoneum along the open channel thus left the congenit why in many cases the hernia is not truly congen is that the funicular portion is only partially under a sudden effort, the septum is broken into the tunica vaginalis.

Hernia of the tunica vaginalis, though rarely so in reality; the tendency is congenital not unfrequently happens, it is true, that early in life, in infants a few weeks or months even the funicular prolongation of the peritoneum is occluded, that the hernia which occurs is of Not unfrequently, however, the hernia does not appear until a considerably later period of life than this, and may thus, Velpeau relates instances in which it occurs at the ages of eighteen and twenty-five. I have seen it in a man of thirty-five years of age, in whom this kind of hernia first appeared at a time when he was twelve years old; and seen it in a man of the Hospital, on a man about fifty, in whom, it would appear that the protrusion had not appeared until thirty years of age.

Symptoms.—The symptoms of hernia in the tunica vaginalis resemble those of the ordinary oblique; most of the time the tumour is much rounded, and the neck is small. The testis, also, cannot be felt distinct and is surrounded by, and, as it were, buried in the tunica vaginalis through which it may sometimes be felt at the scrotum. On inquiry, also, it will usually be found that it has existed in childhood, or the testis has de

is usually partly doughy and partly tympanitic to the feel, has a distinct impulse on coughing, and is readily reducible ; not unfrequently it happens, however, that a portion of the rupture continues irreducible, owing to the existence of adherent omentum. The coverings of an umbilical rupture are usually extremely thin, consisting merely of the peritonæum, a layer of condensed fascia, which is often perforated at several points by circular openings through which the hernia protrudes, and the integuments containing the umbilical cicatrix, which is expanded over the part. The sac generally contains both intestine and omentum, but the stomach and other viscera have been included in it ; and Murray has recorded a case in which the gravid uterus, at the eighth month of pregnancy, formed the contents of an umbilical hernia.

Treatment.—The treatment consists, if the hernia be reducible, in wearing a properly constructed truss ; if irreducible, in applying a hollow cup-shaped pad supported by a bandage over the part. It not unfrequently happens that, in consequence of an indigestible or flatulent meal, an irreducible umbilical rupture in old persons becomes obstructed, the symptoms consisting of tension of the protrusion, with nausea and constipation. In these cases, much discrimination will be required to avoid confounding this passive condition of the tumour with acute strangulation of it. This may be done by attention to the rules laid down (p. 979). By local bloodletting, fomentations, calomel and opium, and enemata, relief may usually be afforded. Should, however, the bowels not speedily act, and stercoraceous vomiting come on, the tumour continuing irreducible, it will be better to cut down upon it, and treat it as a strangulated hernia, dividing adhesions, and reducing the swelling ; for, if it be left obstructed and unrelieved, the whole tumour may run into a state of gangrenous inflammation, and then operative interference will be of little use. In such circumstances death usually results ; but I have known the patient to survive the gangrene, the whole of a coil of intestine and much mesentery and omentum sloughing away, and an incurable artificial anus resulting.

When an umbilical hernia becomes strangulated, as often happens in old irreducible tumours of this description, the symptoms are not usually very acute at first ; but no time should be lost in effecting reduction, if possible, by the taxis, as they speedily assume an active and urgent character. If the taxis fail, the plan that I have usually found to succeed best has been to give the patient three doses of calomel, gr. ij, and opium, gr. j, every second hour ; at the administration of the second dose to apply an ice-bladder ; to keep this on for four hours ; and then to employ the taxis again, when reduction of some portion of the swelling will rarely fail to occur. Should this not succeed, the operation must be proceeded with without further delay, lest gangrene of the tumour set in.

Operation.—The stricture should, if possible, be divided without opening the sac. This may usually be accomplished by drawing the tumour well down, and then making an incision in it about two inches in length over the neck at its upper part in the mesial line. If the tumour overlap here, it may be more convenient to make the incision by the side or even between ; but as a general rule, the upper part is the best. After the division of the integumental structures, and often of a deep layer of fat, the end of the nail may be slipped under the edge of the sharp circular margin through which the protrusion has occurred, and, the stricture being divided away from the sac, and if possible in the mesial line, reduction may be readily and safely accomplished. Should the strangulation not be thus relieved, the sac must be opened, and any stricture divided from within. But the surgeon should

and examine its composition. If it be hard, it will require division, the intestine must be freed from the canal.

Treatment.—The treatment of congenital hernia of the tumour, and the application of a proper compress the whole length of the inguinal canal. A radical cure may be effected in this way ; if a desirable result, the truss must be worn for a long time. The application of a truss with an air-pad will be especially useful, more particularly in children, as it gives greater exactness than an ordinary incompressible pad.

When strangulated, congenital hernia does not require division, and thus necessarily renders an operation more commonly required for this kind of hernia. The operation is the same as that for oblique hernia. When the tunica vaginalis is concerned are usually thinner, the tunica vaginalis requires more caution than usual is required in its dissection, as it contains a large quantity of clear or dark fluid. In fact, a hydrocele conjoined with the hernia is always found in the neck of the sac, is elongated, and narrowed ; hence it is useless to attempt to relieve the strangulation, without laying open the sac from within. As the congenital hernia is often associated with vessels, the section of the stricture may be made in a direction upwards and outwards ; though, there is some doubt as to the exact nature of the case, the stricture directly upwards. The reduction of the hernia will often be prevented by adhesions in the neck of the sac and the testes. I have found both the spermatic cord incorporated with this organ, and requiring its division. In operating upon infants of a very young age, it is necessary to be required, on account of the tension, and the small size of the aperture of the spermatic cord, the veins of which are often found much congested, and of a black or blue color.

A species of congenital hernia has been met with

in children, in which the hernia is in the canal of Nuck, which is a small canal. In one instance I have met with it in a girl of five years old. It is a rare disease, and requires the same treatment as the corresponding disease in the adult.

ENCYSTED HERNIA.

INFANTILE HERNIA, as it is termed, occurs in the upper portion of the tunica vaginalis, or by the insertion of a septum, or by the protrusion of the tunica vaginalis, but in such a manner that it is protruded through the vaginalis, so that it is not in communication with the external opening.



Fig 396.—Infantile Hernia.

can be distinguished from the ordinary congenital hernia. If it becomes strangulated, it must be borne in mind that the tunica vaginalis will first be opened, and the contents of the sac will be exposed.

but the tumour lies behind this sac, and requires to be dissected into through the double serous layer of which it is composed. The stricture will probably be in the neck, and requires to be divided in the usual way.

FEMORAL HERNIA.

By *Femoral Hernia* is usually meant a protrusion that escapes under Poupart's ligament, and enters the sheath of the vessels internally to the femoral vein. This hernia passes down into the innermost compartment of the sheath, which is occupied by fat and lymphatics, and usually contains a gland or two. It passes first of all through the crural ring, where it has Gimbernat's ligament to its inner side; the septum which separates the femoral vein from the inner compartment of the sheath of the vessels, to its outer aspect; Poupart's ligament in front; and the bone behind (Fig. 397). After passing through the crural ring, it enters the crural canal,

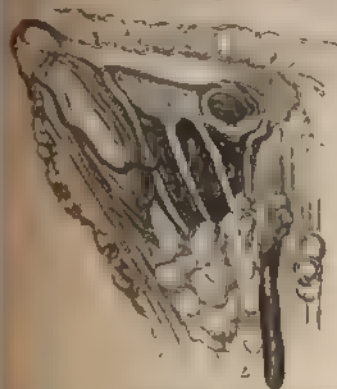


Fig. 398.—Femoral Hernia turning upwards.

Fig. 397.—1. Femoral Artery; 2. Femoral Vein; 3. Innermost Compartment of the Sheath of the Vessels, into which a small Hernia is protruding; 4. Saphenous Vein.

which extends for about an inch and a half down the thigh on the pectineus muscle, and is covered by the iliac prolongation of the fascia lata. As it approaches the lower corner of the saphenous opening where the canal terminates, it passes under the falciform process of the fascia lata, and out upon the thigh through the saphenous aperture; here it expands, becomes rounded, and has often a tendency to turn upwards over Poupart's ligament (Fig. 398), lying in this way upon the iliac region, and sometimes even ascending to some distance upon the anterior abdominal wall. In the descent of the hernia through this course, it first of all pushes before it the peritoneal sac, and then receives an investment of the subserous cellular tissue. It next comes into relation with the *septum crurale*, a mass of dense cellular tissue, containing fat and lymphatics, occupying the crural ring. This septum often becomes incorporated and matted with the contiguous portion of the sheath, thus constituting the *fascia propria* of this hernia, which is commonly thickened, laminated, and of an opaque fatty structure, like omentum. As the hernia continues to descend, it comes into relation with the cribriform fascia, which occupies the saphenous opening, and, lastly, pushes before it the integumental structures.

As the tumour descends through this course, it necessarily comes into relation with very important parts (Fig. 399, p. 1012). Thus it is separated from the femoral vein solely by the septum of the sheath of the vessels. It has the epigastric artery above and to its outer side; and the spermatic cord in the male, or round ligament in the female, almost immediately above it.

The obturator artery, when arising in the normal manner from the internal iliac, does not come into relation with the neck of the sac, but when it takes its origin, as it not unfrequently does, from the external iliac, or common femoral, or the epigastric, it may have important relations to the part of the hernia. Most commonly, under these circumstances, it passes to the iliac or outer side of the neck, but occasionally it winds round the inner or pubic side, coming into rather close relation with it, and then, as will immediately be mentioned, it may be in considerable danger during the operation. The combination, however, of this particular variety of the obturator artery and the femoral hernia, is a very uncommon occurrence, because, in the first place, this internal distribution of the artery is rare, and when it does occur it passes directly over the portion of the femoral vein through which the hernia would protrude, it necessarily strengthens this, and so diminishes the chances of rupture.

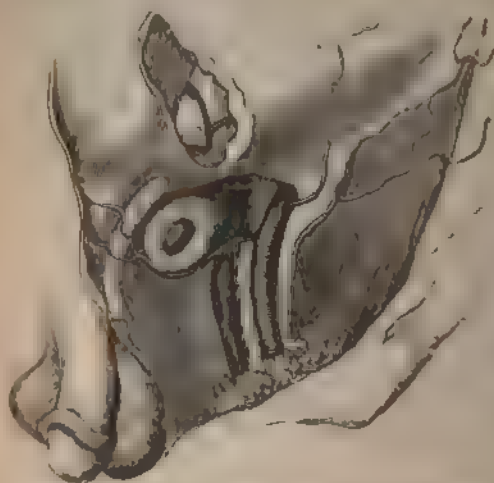


Fig. 599.—1, Femoral Hernia; 2, Femoral Vein; 3, Femoral Artery, giving off; 4, Common Trunk of Epigastric and Obturator Arteries; and 5, Epigastric Artery; 6, Spermatic Cord.

Contents. — The contents of a femoral hernia are usually intestinal, and most commonly consist of a portion of the small intestine. Occasionally omentum is contained within the sac, but seldom in large quantity. I have, however,

several times had occasion to operate in cases of old femoral hernia, in which it became necessary to remove large portions of adherent omentum, in ten and a half ounces, and in the other, about seven. In each case there was a small knuckle of intestine strangulated behind the omentum. The ovaries, Fallopian tubes, &c., have been known to be strangulated in this variety of hernia.

Symptoms.—The symptoms of femoral hernia are usually well marked. They consist of a tolerably firm, tense, and unyielding tumour, of a rounded shape, situated in the groin, to the inner side of the femoral vessels, having its neck under Poupart's ligament, though, as it increases in size, its base may be turned above this structure; sometimes, though rarely, it passes upwards upon the thigh. Its size varies considerably; most commonly it is larger than a walnut or a pigeon's egg, and then is deeply seated in the angle between the body of the pubes and the femoral vessels, but occasionally it may attain a considerable bulk, as large as the fist or a small roll. When large, this hernia usually rises up above Poupart's ligament, and extends outwards in a direction parallel to it, so that it assumes an elongated shape; it is then usually somewhat doughy and soft, even when strangulated; very different from the excessively tense feel that it has when small.

In some rare cases the femoral hernia has been found lying external to the vessels, the mouth of the sac being between them and the iliac space.

Under these circumstances strangulation cannot well occur, inasmuch as the mouth will be the widest part of the sac; but, as Hesselbach has observed, if the fascia laca be torn by the pressure of the tumour, the rupture may be strangled in the aperture thus formed. Should an operation ever be required under such circumstances, it must be borne in mind that the circumflex iliac artery may be in some danger.

Diagnosis.—The diagnosis of femoral hernia is not always easy. When the hernia is large, and more particularly when it rises up above Poupart's ligament, which some herniæ, even of very moderate size, are apt to do, it might at first be mistaken for an inguinal rupture. The diagnosis, however, may usually be effected by ascertaining the relation that the neck of the sac has to Poupart's ligament, the inguinal hernia being situated *above*, the femoral *below* this cord. When, however, a small femoral hernia in a fat man rises upwards, so as to overlie Poupart's ligament, it resembles very closely an incomplete inguinal hernia; but its characters may be determined by the passage of the finger up the inguinal canal, which will be found to be free, and the hernia can only be felt through its posterior and inferior wall. In the female the finger cannot be passed up the canal, but the inguinal hernia will descend into the labium, and may thus be recognised from the femoral, which lies in the upper and inner part of the thigh. After reducing a femoral hernia, the finger also can usually be pushed into the inferior aperture of the crural canal, when the situation and sharp outline of the falciform process will determine the nature of the opening through which the protrusion has occurred.

The diseases occurring in the groin, with which femoral hernia may most readily be confounded, are—1. *Enlarged lymphatic glands* in this situation. From these it may be distinguished by the absence of impulse in the glandular tumour, and by the simultaneous enlargement of several glands. A small strangulated hernia may, however, co-exist with these; being subjacent to, and covered in by them. When this is the case, and the local signs of hernia are obscure, whilst the symptoms of strangulation continue, an incision should be made into the part, and the dissection carefully carried through and underneath the glands, with the view of determining whether the hernia exist or not. 2. *A small fatty growth* has been met with in the crural canal, simulating closely a hernia. The want of impulse on coughing, together with its limited and doughy character, and the absence of circumscription in the tumour, will enable the surgeon to distinguish it from hernia. 3. *Psoas abscess* not unfrequently points very nearly in the situation of femoral hernia. From this it may, however, be distinguished by its fluctuating feel, soft, yet semi-elastic character, and by the general history of the case. The impulse on coughing, which is very distinct in the abscess, is commonly more forcible and direct than that of a hernia; and although the purulent collection may in many cases be squeezed back into the abdomen when the patient lies down, yet it returns without a gurgle, and without that distinct slip which accompanies the reduction of a hernia. 4. *Varix of the saphena vein* is in some danger of being confounded with hernia. It may, however, be distinguished from this by the impulse in it being less distinct, and by the enlargement of the lower part of the vein being marked in the varix, but not existing in the rupture.

Femoral hernia most commonly occurs in women, and very seldom under the age of twenty; differing in both these respects from the inguinal rupture. Sir A. Cooper states that he had only seen three cases under the above age. It very seldom becomes strangulated at an early period of life, even when existing. *I have had a girl of nineteen under my care with femoral hernia,*

in whom strangulation had already occurred on four occasions, reduction, however, having been happily effected each time.

Treatment.—The treatment of femoral hernia, when it is reducible, must be conducted in the ordinary way by the application of a proper truss. A cure, however, is never, I believe, effected by the pressure of a pad as sometimes happens in inguinal hernia; owing probably to the rigidity and incompressibility of the tendinous and aponeurotic structures through which this rupture protrudes. It is difficult to keep this form of hernia by means of a truss. The best instrument for this purpose is, I think, the moorain truss, which I have found to succeed when all others have failed. When the hernia is irreducible, it should be supported by means of a truss with a concave pad.

When a femoral rupture is strangulated, reduction should be effected either by taxis or operation as speedily as possible, gangrene more rapidly ensuing in this than in any other form of hernia. In attempting the taxis, the structures in the groin should be well relaxed by bending the body forward and flexing the thigh upon the abdomen; if it do not succeed with the assistance of the means recommended at page 981, the operation should be proceeded with at once. The operation for strangulated femoral hernia may be undertaken earlier and with a better prospect of success than in any other form of rupture; this is owing to the stricture being so commonly seated outside the sac, that the operation usually admits of being completed without unfastening the peritoneum. The advantage of this mode of procedure in femoral hernia has been fully pointed out by A. Key, Luke, and Gay, and is now, I think, pretty generally recognised and practised. Mr. Gay more particularly, in his work on *Femoral Hernia*, has pointed out that the stricture may commonly be divided without opening the sac, by making a very limited incision on the inner side of the neck of the tumour, and he justly observes that the operation undertaken in this manner is done more than the taxis with the addition of a superficial incision.

The stricture in femoral hernia is often found to be occasioned by the pressure of the crural arch. Lawrence states that it may be most effectively relieved by dividing the thin posterior border of this arch near the junction. Other surgeons recommend that the sharp edge of Gimbernat's ligament should be divided; and others again that the division should be made at the junction of Gimbernat's and Poupart's ligaments, through those ligamentous bands which go by the name of Hey's or the ilio-femoral ligament, at the inner edge of the falciform process; and, indeed, it is in this stricture that both Lawrence and Hey direct the incision to be made. In operating for femoral hernia, I have certainly most frequently found the stricture not to continue after the division of these ligamentous structures, and to be occasioned by fibrous bands, often very distinct, narrow, and glistening, lying across the neck of the sac in the fascia propria of the hernia; and I agree with the opinion expressed by Sir A. Cooper, that the neck of the sheath is the common seat of strangulation in femoral hernia; these transverse fibres, which sometimes appear to be partially reticulated, consisting probably of a condensation of the tendinous fibres that are normally found in the sheath of the vessels. In order to expose them, it is commonly necessary to draw the neck of the sac well down, when they will be seen deeply to indent and constrict it.

The operation without opening the sac may most conveniently be performed, when the tumour is small, by making an incision along the inner side of its neck, and then dissecting through the superficial structures until the fascia propria is exposed and carefully opened, and then the sac exposed.

The point of the finger should then be carried to the lower side of this, well under the fascia propria. The finger-nail or a flat director may then be insinuated under the sharp edge of Gimbernat's ligament; which, at the point of junction with Poupart's, may be divided upwards and inwards to the extent of a line or two by means of a hernia-knife. By this incision, not only is the edge of Gimbernat's and Poupart's ligament divided, but also the condensed and compressed fascia propria lying between the sac and the inner side of the crural arch. The reduction may now be attempted, and often effected; should any obstacle exist, the neck of the sac must be well drawn down and exposed, and any transverse bands situated upon it dissected through with the scalpel and forceps, or divided on a director. These bands lie in the fascia propria; and when they are found, it is usually owing to the surgeon not having closed the neck of the sac sufficiently before passing his nail or director under the stricture. It is owing to the incision being confined to the constrictions occasioned by the crural arch only, not including, as it ought to do, the subjacent condensed fascia propria; a point of very great practical importance. Sometimes this condensed and constricting portion of the fascia propria is so closely incorporated with the neck of the sac, that it cannot be divided without opening the latter. The operation performed in this way, without opening the sac, is certainly a very simple procedure, and adds little to the danger of the patient.

If it be thought desirable to *open the sac*, or if it be necessary to do so in consequence of its incorporation with the fascia propria, the operation must be performed in a different manner, the parts requiring to be rather fully exposed; and indeed, if the tumour be of any considerable magnitude, even though the sac be not opened, it will be better to expose the part somewhat more freely in the way to be described. An incision should be made parallel to Poupart's ligament, by pinching up the skin, and then a transverse cut from the centre of this carried over the tumour so as to present the following shape

: the dissection must then be carried through the superficial fascia, when the septum crurale or fascia propria will be exposed; in some cases, especially if the hernia be a large one, this is thin, and requires to be carefully slit up on a director. In many instances, however, it is so dense, laminated, and changed in structure, as scarcely to be recognised for what it is. It not unfrequently happens that, after the superficial fascia has been divided, an oval, smooth, and firm body is exposed, which at first looks like the hernial sac, or a lump of omentum; this is in reality the fascia propria, thickened by the long-continued pressure of the truss, and congested perhaps by the attempts at reduction; and in the midst of it, the sac will at last be found, after the dissection has been carried through several layers of this tissue. In it cysts containing bloody serum may occasionally be found, and then the difficulty in the recognition of the structures is greatly increased. Though the mobility of this mass, the facility of tracing its neck, and the roundness of its general outline, often cause it to be mistaken for sac or omentum, it may be distinguished from the first by the absence of the characteristic vessels upon its surface, and from the second by its more rounded, solid feel, and uniform appearance. When the sac has been reached, it must be very carefully opened, there being usually very little if any fluid between it and its contents; the finger-nail must then be passed under the sharp edge of the stricture, which should be divided in a direction upwards and inwards. The reason why this line of incision is universally chosen by surgeons in this country at the present day, is, that it is the only direction in which the stricture can be

usually partly doughy and partly tympanitic to the feel, has a distinct impulse on coughing, and is readily reducible; not unfrequently it happens, however, that a portion of the rupture continues irreducible, owing to the existence of adherent omentum. The coverings of an umbilical rupture are usually extremely thin, consisting merely of the peritoneum, a layer of condensed fascia, which is often perforated at several points by circular openings through which the hernia protrudes, and the integuments containing the umbilical cicatrix, which is expanded over the part. The sac generally contains both intestine and omentum, but the stomach and other viscera have been included in it; and Murray has recorded a case in which the gravid uterus, at the eighth month of pregnancy, formed the contents of an umbilical hernia.

Treatment.—The treatment consists, if the hernia be reducible, in wearing a properly constructed truss; if irreducible, in applying a hollow cup-shaped and supported by a bandage over the part. It not unfrequently happens that, in consequence of an indigestible or flatulent meal, an irreducible umbilical rupture in old persons becomes obstructed, the symptoms consisting of tension of the protrusion, with nausea and constipation. In these cases, much discrimination will be required to avoid confounding this passive condition of the tumour with acute strangulation of it. This may be done by attention to the rules laid down (p. 979). By local bloodletting, fomentations, calomel and opium, and enemata, relief may usually be afforded. Should, however, the bowels not speedily act, and stercoraceous vomiting come on, the tumour continuing irreducible, it will be better to cut down upon it, and treat it as a strangulated hernia, dividing adhesions, and reducing the swelling; for, if it be left obstructed and unreduced, the whole tumour may run into a state of gangrenous inflammation, and then operative interference will be of little use. In such circumstances death usually results; but I have known the patient to survive the gangrene, the whole of a coil of intestine and much mesentery and omentum sloughing away, and an incurable artificial anus resulting.

When an umbilical hernia becomes strangulated, as often happens in old irreducible tumours of this description, the symptoms are not usually very acute at first; but no time should be lost in effecting reduction, if possible, by the taxis, as they speedily assume an active and urgent character. If the taxis fail, the plan that I have usually found to succeed best has been to give the patient three doses of calomel, gr. ij, and opium, gr. j, every second hour; at the administration of the second dose to apply an ice-bladder; to keep this on for four hours; and then to employ the taxis again, when reduction of some portion of the swelling will rarely fail to occur. Should this not succeed, the operation must be proceeded with without further delay, lest gangrene of the tumour set in.

Operation.—The stricture should, if possible, be divided without opening the sac. This may usually be accomplished by drawing the tumour well down, and then making an incision in it about two inches in length over the neck at its upper part in the mesial line. If the tumour overlap here, it may be more convenient to make the incision by the side or even between; but as a general rule, the upper part is the best. After the division of the integumental structures, and often of a deep layer of fat, the end of the nail may be slipped under the edge of the sharp circular margin through which the protrusion has occurred, and, the stricture being divided away from the sac, and if possible in the mesial line, reduction may be readily and safely accomplished. Should the strangulation not be thus relieved, the sac must be opened, and any stricture divided from within. But the surgeon should

exhaust every means before he opens the s^cially of large size, the patient I believe rare—much less frequently, so far as my experience goes. Sometimes, after the external division, I found that there is an internal strangulation slipped through an aperture formed by the covering the sac; if so, the edge of this requires division. Sir A. Cooper mentions tumours, having a communication between in which the tumour resembled a figure of down the middle of the sac. In such cases uncommon, central constriction may require stricture at the neck of the sac. Adherences be left in the sac in cases of umbilical hernia, omentum must be treated upon general principles. Strangulation of an umbilical hernia occurs; this happen, the operation must be performed not complicate the case much, and instances Lawrence, and others, of its successful performance the division of the strictures and the reduction of the hernia, and be retained in position by a flannel roller.

OTHER VARIETIES OF

VENTRAL HERNIA.—By ventral hernia is meant one which occurs through any part of the abdominal wall, femoral, or the umbilical apertures; they are situated between the recti muscles, the linea alba, in this situation during parturition, and increase in size. A case was once sent to me from the long triangular gap through the upper part of the linea alba from the umbilicus to the ensiform cartilage, which had taken place that was nearly as large as a fistula. I have also been met with in the linea semilunaris and iliac regions; and Cloquet describes a region. When these hernia happen in the abdomen, they are apt to occasion dyspeptic symptoms as Lawrence is doubtless right in thinking that they arise from the implication of the stomach, but sometimes different protrusions have occasionally been met with by which the anterior abdominal wall has been ruptured, seldom, if ever, take place below the umbilicus, and are of traumatic cause.

Treatment.—The treatment of ventral hernia is to reduce the tumour by means of a broad belt and prevent it from becoming strangulated, which I believe very rarely happens. If the width of the neck of the sac, the operation is performed in the same way as for umbilical rupture, care being taken to divide the integuments, any aponeurotic investments, and the stricture should always be divided upwards.

A rare kind of ventral rupture has been described by German surgeons, in which the abdominal wall is ruptured to such an extent, forming a broad and expanded wound.

pedicle. Sometimes this tumour may attain an immense size, stretching perhaps down to the knees, and containing even the gravid uterus.

OBTURATOR HERNIA.—The occurrence of this form of hernia is extremely rare, and its existence has still more rarely been determined until after death; in fact, Lawrence seems to doubt the possibility of the recognition of this complaint during life, in consequence of the small size which the tumour attains, and its being covered in by and compressed under the pectineus muscle. Two instances have, however, been recorded, one by Otre, the other by Bransby Cooper, in which a strangulated hernia of this kind was recognised during life. And these are probably the only instances on record in which an operation has been successfully performed; almost all the other cases mentioned by writers having been accidentally discovered after death, which had occurred from internal strangulation, the precise seat of which could not be detected. In Obré's case, the patient was seized with symptoms of strangulation, but no tumour could be detected in any of the ordinary seats of hernia. "On uncovering the upper part of both thighs at the same time, the eye detected a slight degree of fulness in Scarpa's triangle on the right side; this triangle of the opposite limb was well marked with a hollow, or depression passing down its centre, but this was lost on the affected side, and the whole contour of this part of the limb was visibly fuller than that of the corresponding one. There was no tumour or circumscribed swelling, but on standing over the patient, and using firm pressure with the ends of the fingers over the neighbourhood of the femoral artery, and a little below the saphenous opening, a distinct hardness could be felt (slight in its extent), giving an impression as if the sheath of the vessels were being pressed on." Taking the dangerous state of the patient into consideration, Mr. Obré acted in accordance with the best rules of surgery; and, thinking that there might be a hernia deeply strangulated in the femoral canal, he made an incision downwards in this situation, but was disappointed on finding, when the saphenous opening was exposed, that there was no intestine confined there. As, however, a hardened structure could be deeply felt at the inner border of the opening, the fascia lata was exposed, and the pectineus muscle divided to the extent of about two inches, when a hernial sac of about the size of a pigeon's egg, and containing intestine, came into view. In this operation the saphenous vein gave some trouble, lying in the course of the incision. The sac having been laid open, the structure was divided upwards, during which part of the procedure the vein was accidentally cut, and required ligature; no other vessel was tied. The operation, which reflects the greatest credit on Mr. Obré's diagnostic skill and dexterity, was perfectly successful, the patient making an excellent recovery.

Besides the obturator, various other pelvic herniæ may take place, such as a protrusion into the perineum, the vagina, or through the sciatic notch. These various forms of rupture are of extreme rarity, and present many difficulties in their diagnosis.

PERINEAL HERNIA commonly occurs in the middle line, between the rectum and the bladder in men, or the rectum and vagina in women; but sometimes the protrusion has been known to take place by the side of the anus, or even in front of this. Of these various forms of rupture, many instances have been collected by Lawrence from different writers. The Treatment of such a hernia would consist in supporting the protrusion by means of a pad and bandage; as the mouth of the sac is very large in these cases, it is not probable that any strangulation would occur.

VAGINAL HERNIA has occasionally been met with; the tumour protruding

through the posterior or upper wall of the nary characters of this disease, such as imp It may most conveniently be kept up by m

PERIDENDAL HERNIA has been described, resembling vaginal rupture. The situation be mistaken for an inguinal hernia; but fit the upper part of the labium and the ring tumour presenting the ordinary characters lower part of the labium, and forms a prot of the vagina.

SCIATIC HERNIA.—This rare form of I A. Cooper as passing through the sciatic lower border of the pyriform muscle and t in close relation with the sciatic nerve, and In the case related by Cooper, the obtura vein below the neck of the sac. From t would be seated, and its small size, it wo during life; but, if detected, it might proper bandages and a pad. Should ope strangulation, the deep incisions must be ca the great importance of the parts surroundi

DIAPHRAGMATIC HERNIA.—This form of rence, and, I believe, always results in cons of the diaphragm. It usually attains a la the stomach or the transverse colon, with form a tumour in the thoracic cavity, et pushing the heart to one side. This heral sac, but has been found partially envel believe, only been met with in the left sid the liver on the right side preventing its case affords a very good instance of this ven

A man, seventy-four years of age, was Hospital. About twelve months before, he deep; he believed that he injured his chest had suffered much from shortness of bre suffocation, had a hacking cough, and cou some difficulty in breathing. At the time about three spoonfuls of blood. Ever since from dyspeptic symptoms and constipation, injury he had experienced no inconvenience before admission, the difficulty in breathing he came to the hospital, violent pain in bowels ceased to act, although he took a va had enemata containing croton oil administ

On admission, the abdomen was found in panitic, with pain around the umbilicus; the brown, moist fur; the pulse was small, there was nausea, but no vomiting. The abd anxious; the bowels had not acted for a desire to go to stool. He was ordered an hour. As this had no effect, he was directed pills, and to have turpentine enemata, though they brought away no feces. The skin cold and flabby, the countenance mor

and the abdomen more tympanitic, and he died two days after admission, and nine from the commencement of the obstruction.

Examination of the body twenty-four hours after death.—The abdomen was distended and tympanitic, and the peritoneal sac contained about six ounces of fluid, with here and there patches of recently effused lymph. The small intestines were not distended: the large were greatly distended with æræ, the cæcum extending into the cavity of the pelvis; the ascending and the transverse colon were much distended, and it was found that a large loop of the transverse and of the descending colon had passed through an opening in the cordiform tendon of the diaphragm into the pleural sac, and was there strangulated (Fig. 400). The colon below the stricture was

contracted, and entirely empty. On opening the thorax, the loop of intestine, fourteen inches in length, of a pale slate colour, and distended with gas, was found in the left pleural sac. It reached as high as the fifth rib, touched the pericardium, and was overlapped by the free margin of the left lung. Where strangulated, it was of a darker colour than elsewhere. The opening in the diaphragm, through which it had passed, admitted little more than the point of the forefinger, and had a thin tendinous margin. The tenth and eleventh ribs, on the left side, were found to have been fractured; the latter was united by osseous matter, but the tenth rib, at the seat of fracture, had formed a false joint. Connected with this and with the intercostal space below it, was a firm adhesion about an inch broad, and an inch and a half long, united by its other extremity in the protruded meso-colon and the diaphragm. The protruded meso-colon was firmly adherent to the upper surface of the diaphragm; close to the opening in it, the lungs were tolerably healthy. The right pleura contained three ounces, and the left eight ounces of serum.



Fig. 400.—Diaphragmatic Hernia.

CHAPTER LXIII.

INTESTINAL OBSTRUCTION.

Intestinal Obstructions may be of two distinct kinds, the *Acute* and the *Chronic*, which should not be confounded with one another, as they are usually dependent upon very different conditions, and require different lines of treatment to be adopted for their relief.

ACUTE INTESTINAL OBSTRUCTION.—This may arise from five different causes. 1. It most commonly occurs in consequence of the formation of an internal hernia, which becomes suddenly strangulated, a portion of gut slipping through an aperture in the mesentery, or omentum (Fig. 401), or becoming constricted by bands, adhesions, or diverticula, stretching across

from one side of the abdomen to the other. 2. It may occur from invagination or intussusception, the upper portion of the intestine slipping into



Fig 401.—Intestinal Obstruction from Internal Hernia.

lower. 3. It may be produced by a portion of gut becoming twisted upon itself, and thus forming a volvulus, owing to the mesentery or mesocolon being unusually long, and allowing a half-twist to take place, the consequence of which complete obstruction occurs. 4. In other instances, as Phillips has pointed out, the same train of symptoms may arise in consequence of malignant stricture gradually closing, and then at last becoming suddenly occluded.

It is of much importance

in practice to bear in mind that severe and even fatal intestinal obstruction may occur, simply from spasmodic causes, or as the result of inflammatory affections of the abdomen, without the existence of any mechanical lesion.

Symptoms.—The symptoms of acute intestinal obstruction, when arising from a mechanical cause, such as the formation of an internal hernia, or volvulus, are always characterised by very marked vital depression. The first symptom is constipation, it is true, from the very first; but this symptom is not the most prominent one, and those that result are evidently, as in an ordinary case of strangulated hernia, the consequence of the injury inflicted upon the intestine, rather than of the mere mechanical obstacle to the onward passage of the feces. At the moment of the occurrence of the attack, the patient is usually seized with a sudden feeling of something wrong having taken place in the abdomen; or he is struck with intense pain at one point. There may be sudden syncope, though most usually the depression of vital power does not amount to this. Vomiting speedily occurs; at first of the contents of the stomach, but after a time of a stercoraceous character; sometimes assumes this form almost from the very first. The abdomen becomes swollen and tender, the intestines being blown up with flatus, so as to give rise to immense tympanitic distension, rolling over one another, and occasioning loud rumbling and gurgling noises. If the abdominal walls be thin, the rolling of the intestines may be distinctly felt, and in many cases seen through them: and may sometimes be observed to be continued up to one spot, where it ceases. At this point an intumescence may sometimes be indistinctly felt corresponding to the seat of strangulation. If relief be not afforded, the sufferings of the patient become very considerable, and the mental distress agonising; the vomiting, perhaps, becomes less frequent, but the depression increases, and at last death results, usually about the sixth to the tenth day, though sometimes sooner, from exhaustion, peritonitis, and gangrene conjoined, the mind being clear to the last, and the patient's attention being intently and distressingly riveted upon the possibility of getting relief from the bowels.

CHRONIC INTESTINAL OBSTRUCTION.—This usually arises from one of three causes; viz., 1, the gradual obliteration of the inferior portion of the large intestine, in consequence of the malignant degeneration of its walls; 2, the compression of the gut by a tumour growing near it; or 3, the obstruction

of its cavity by the accumulation of large masses of hardened feculent matters.

The *Symptoms*, in the earlier stages of these cases, are commonly those that will be described as indicating stricture of the large intestine; but, when once complete obstruction has come on, the constipation becomes the most prominent symptom. In some instances this will occur without any antecedent leading to the supposition of the existence of stricture. There may be comparatively little constitutional disturbance at first, but the bowels cannot be made to act, and any attempt at forcing their operation by the administration of purgatives, gives rise to sickness and much distress. During the progress of the attack, eructations, retchings, and even vomiting, are of frequent occurrence, but it seldom happens that this is stercoraceous till the very last; there may be much tympanitis, with rumbling and gurgling of the intestines, but most frequently the abdomen fills slowly and gradually, and these symptoms do not occur until after some days have elapsed. The distress of the patient does not depend so much on the length of time that the obstruction has existed, as on the amount of tympanitic distension of the abdomen. The greater this is, the more urgent will be the symptoms. In many instances, life is prolonged for several weeks, for five or six, even after complete obstruction has set in; and in some cases a recovery may take place even though a very considerable time have elapsed from the occurrence of the obstruction. In a lady whom I attended some time ago, with Mr. Powell, recovery took place, although there had been complete obstruction for upwards of five weeks.

DIAGNOSIS.—I. The diagnosis of the *causes* of the obstruction is of great importance; attention as to whether it assume the acute or the chronic form, will throw some light upon the conditions that occasion it. It is often difficult to determine whether the obstruction is mechanical, or whether it depends upon a spasmodic or inflammatory affection of the intestine. The practice to be adopted in any particular case must at last be determined by a history of the symptoms, by a careful exploration of the abdomen and rectum, and by the light that can thus be thrown upon the question, as to whether the obstruction in the particular case be dependent on causes that are removable or not by medical means. In many instances, the history of the case, the assemblage of strongly marked symptoms, and the result of abdominal and rectal exploration, enable the surgeon to determine, without much difficulty, that the obstruction is dependent on causes that are not removable by any means short of operative interference. But, in other cases, no means that we possess enable us to arrive at a correct or even an approximate diagnosis. Cases are recorded that have ended fatally from obstruction in forty eight hours, without sickness, fixed pain in the abdomen, or tympanitis. These, however, are certainly exceptional, and do not bear upon the question as to the propriety of performing gastrotomy in those instances in which it can be satisfactorily determined that a mechanical obstacle, not removable by medical means, exists. That the diagnosis may so far be effected with tolerable certainty is evident, from the fact that in all those cases of gastrotomy which have been of late years practised in this country, by Luke, Hilton, Avery, and myself, mechanical obstruction, irremovable by any but operative interference, was found.

The most prominent symptoms, and those that will chiefly engage the surgeon's attention, are—1, the Duration of the Constipation; 2, the Occurrence of fixed Local Pain in the Abdomen; and 3, the Character of the Vomited Matters.

1. *The Duration of the Constipation* does not throw much light upon the

cause. Indeed, if patients be naturally costive, constipation may last for considerable number of days, or even weeks, without producing any serious or fatal consequences. Most practitioners must have seen cases in which constipation has continued for three or four weeks, without destroying the patient. Dr. Johnson mentions a case, in which it lasted during forty-six days. In these cases, however, constipation has usually come on gradually, being, as it were, an aggravation of the patient's natural condition. In cases of acute internal strangulation, the constipation is always sudden, and is accompanied or speedily followed by other symptoms, indicating intestinal obstruction.

2. *The Occurrence of Fixed Pain* is common to many conditions of the abdomen; though, when taken in conjunction with the sudden supervention of obstruction to the onward passage of the feces, with more or less tumefaction corresponding to the seat of pain, and more especially with the nausea, a symptom to which I shall advert, it is not without considerable value in the diagnosis of these cases.

3. *The Character of the Vomiting.*—When the obstruction is not dependent on complete mechanical occlusion of the bowel, there may be incessant vomiting, and the stomach may reject its contents as often as anything introduced into it; but the vomiting will not be feculent in the majority of cases, however obstinate the constipation may be, and however long it may last. If, however, there be complete mechanical occlusion, feculent vomiting most commonly sets in early, frequently by the third day, or even sooner, and will continue until the cause of occlusion be removed. The vomiting, however, is not continuous, but will usually occur only after food has been taken into the stomach. It is true that feculent vomiting is not sufficient by itself to determine the diagnosis; and that it may occur in cases of pure spasmodic ileus, in which the obstruction is removable by medical means. A remarkable case of this kind occurred a few years ago at the Westminster Hospital, under Dr. Basham, in the person of a black woman, who was admitted for hæmatemesis, with catamenial suppression. The stomach was very irritable, with occasional colicky pains in the abdomen for the first two weeks. The bowels, although torpid, were not completely occluded for within forty-eight hours of the stercoraceous vomiting. This latter condition continued for five weeks altogether, with an interval in which the bowels acted; indeed, towards the latter period of the case, feculent vomiting occurred on the same day that a small alvine evacuation was obtained. She suffered during a greater part of this period from dysuria. There was also frequent spasmodic constriction of the rectum; and altogether much hyæmia was mixed up with the symptoms. The stercoraceous vomiting gradually abated, the natural order of things returned, and she left the hospital sufficiently well to walk to Portsmouth in three days. It is, therefore, necessary to bear in mind the occasional dependence of feculent vomiting on pure spasmodic ileus, or on other conditions that are removable by medical aid alone, as that it may be absent in cases in which the obstruction, whether seated in the small or in the large intestine, is not under the influence of medical treatment, and can only be relieved by surgical assistance. But I believe that a careful exploration of the abdomen and rectum, and a proper inquiry into the history of the case, will most generally prevent the surgeon from being led into any serious error by trusting too implicitly to the presence or absence of this one symptom.

The following may be given as a summary of the general diagnostic signs.
1. In *internal hernia* the suddenness of the symptoms, the prostration or syncope, fixed pains and vomiting, will throw light on the condition. 2. In *int-*

absorption, the early age, the fixed pain, with elongated tumour, to be chiefly felt on palpation, and possibly through the rectum, with bloody mucous stools and tenesmus, are the chief signs. 3. In *Volvulus* the signs of internal strangulation, with very unequal distension of the abdomen, great tympanitis on one side and flattening on the other, are met with. 4. In *Chronic structure* suddenly occluded, the sudden aggravation of the previous long-continued difficulty in defecation will clear up the diagnosis.

2. After determining whether the obstruction be dependent on causes that are removable or not, the next most important point is doubtless to ascertain whether the obstruction is seated in the large or in the small intestine. In general, there may be no great difficulty in coming to an accurate opinion on this point, if it be borne in mind that, with the exception of volvulus, obstructions of the large intestines are most generally chronic, whilst those of the small are, in by far the majority of cases if not invariably, acute in their character. The earlier occurrence of feculent vomiting when the obstruction is in the small intestine, the greater tympanitic distension and bulging in the course of the cæcum and colon when it is seated in the large intestine; the amount of urinary secretion, being, as was pointed out by Hilton and G. Bird, less in the former than in the latter case; and the result of careful exploration of the rectum, will most commonly enable the surgeon to decide this question with sufficient precision to guide him in the choice of an operation. Yet cases do occur in which, though the obstruction be seated in the large intestine, the symptoms are acute, and evidently not dependent on chronic obstructive disease, the vomiting is of early occurrence, the distension of the abdomen slight, and exploration by the rectum yields no result; and it is in cases of this description, presenting a train of symptoms of mixed and uncertain character, that the diagnosis of the precise seat of the obstruction cannot be made.

The question as to whether the cavity of the peritoneum should be opened or not, will altogether turn, in any given case of intestinal obstruction dependent on causes that cannot be removed without operative interference, on the point, whether such obstructing cause implicates the bowel above or below the lower end of the descending colon.

a. When the obstruction is situated *below the descending colon*, exploration of the rectum will usually determine to what cause it is more immediately referable. Thus it may be owing to strangulation of internal piles; to compression of the rectum by an over-distended bladder; or to an enlarged uterus, engorged and tilted backwards so as to compress and constrict the rectum, and thus to lead to the supposition of the existence of tumour. If the intestinal obstruction be owing to one or the other of these causes, it may readily be relieved by appropriate treatment. It, however, more commonly proceeds from other conditions in this situation, that do not admit of relief except by operative interference; as from constriction, simple or malignant, of the upper portion of the rectum, or of the lower part of the sigmoid flexure of the colon, in consequence of the pressure of a pelvic tumour, or of a stricture from fibrous or cancerous degeneration of this part of the wall of the gut. Under these circumstances, the obstruction may be as complete as in a case of internal strangulation, and the patient will inevitably perish unless relieved by operation. But there is this important difference between the operative interference that may be called for by these obstructions that are situated below the descending colon, and those at a higher point in the intestinal canal—that in the latter case the peritoneum must be opened; whilst, in the former, relief may be given without interfering with the cavity of the peritoneum, by the operation of opening the

descending colon in the left, or the cœcum in the right lumbar region between the reflexions of the peritoneum at the part where the gut is covered by that membrane.

β. When the obstruction is situated *above the descending colon*, it almost always occurs in the small intestine, rarely in the cœcum or transverse colon, and may be dependent on various causes, some of which are removable, others not, and of which preparations may be found in all the large pathological collections in London. Thus, it may be the result of internal strangulation, either occasioned by the small intestine falling into a pocket formed by the meso-colon, or by the constriction of the gut by the passage across it of adventitious bands of fibres. It may be occasioned by intussusception, by the lodgment of biliary or other similar concretions, or by mere spasm of the small intestine, which may be so persistent as to prove fatal. This is, doubtless, a rare occurrence; but cases of the kind are on record, in which the only *post mortem* appearance that could be discovered has been a spasmodically contracted ileum. The great practical difficulty in all these cases of obstruction, above the sigmoid flexure of the colon, is to determine the cause of the obstruction, whether it be of such a nature that it may be removed by operation or not. In some of the cases mentioned there may be special symptoms, which lead to a tolerably correct diagnosis. Thus, in intussusception, bloody and mucous stools and the existence of a long oblong indurated swelling may give a clue; and in children, as the intussusception usually takes place through the ileo-colic valve, the mass of prolapsed intestine may often be felt in the rectum. In malignant or fibrous degeneration of the colon, the chronic nature of the disease, the history of the case, and the appearance of the patient, may indicate the nature of the obstructing cause.

TREATMENT.—*Treatment of Acute Obstruction.*—This must necessarily in a great measure be determined by the diagnosis that is made as to its cause. Before proceeding to the employment of any measures, whether medical or surgical, in these cases, the surgeon should never omit to institute a careful examination of the various abdominal and pelvic apertures for some of the more obscure forms of external hernia; for in cases of supposed internal strangulation, it has occasionally turned out, after death, that the patient had been labouring under a small femoral, obturator, or sciatic hernia. If such a condition be detected, it must of course be relieved by proper operative means. In the event of no such protrusion being detected, and from the general obscurity of the symptoms in these cases rendering an exact diagnosis in the earlier stages almost impossible, it is generally expedient to try the effect of proper medical treatment, which will sometimes, even in apparently hopeless cases, afford relief. The only plan of treatment that appears to me of any value is the continued administration of calomel and opium, with the free application of leeches to the abdomen, followed by fomentations; this will be of considerable service, and in some cases, even the most hopeless and complicated, will afford satisfactory results. In a very complicated case of intestinal obstruction which I attended with Dr. Garrod, this plan was eminently successful. A patient was admitted into the hospital under Dr. Garrod, having symptoms of internal strangulation; he had at the same time double inguinal hernia, and a small umbilical rupture, as well as the remains of a fatty tumour, which had been partially removed from the abdominal wall many years previously. There were peritonitis with tympanitis, stercoraceous vomiting, and much depression of power; but, as there was no strangulation existing about any of the external apertures, and as there was no evidence as to the precise locality of the

internal mischief, it was not thought advisable to have recourse to operation. The patient was accordingly treated with calomel and opium, together with other antiphlogistic means, when, on the tenth day, the obstruction gave way and the bowels acted, the case ultimately doing well.

Inflation of the Obstructed Intestine, by the injection of air into the rectum, has been recommended in cases of intussusception, and has occasionally been practised with success. In two instances I have successfully had recourse to it. One was the case of an infant, a few months old, seized with symptoms of intussusception, whom I attended with Mr. Cousins. The other patient was a young lady about ten years of age, to whom I was called in to consultation with Drs. Murphy, Watson, and West; inflation was performed on the fifth day after the setting in of symptoms of acute intestinal obstruction, apparently dependent on intussusception. The proceeding was followed by perfect success: the child felt "as if a bone broke" in the abdomen, the obstruction was removed, and motions followed in three hours, though all the previous treatment had been unavailing. For the convenient performance of this operation, I have had an apparatus constructed, consisting of a circular double-action bellows, with a long vulcanised India-rubber tube, furnished with a stop-cock and rectum-tubes of different sizes for children and adults. Should this not be at hand, a well-fitted stomach-pump will answer the purpose. When the air is pumped in, it is doubtful whether it passes beyond the ilio-cæcal valve; but this is of little consequence, in children especially, in whom the inflation of the large intestine alone may be quite sufficient, the obstruction often consisting of the slipping of a portion of the small intestine through the ilio-cæcal aperture.

If, however, for any of the various reasons that have already been mentioned, an internal strangulation of some kind be diagnosed, attended by urgent symptoms, and threatening the life of the patient, the great questions to be determined are, whether it is advisable to have recourse to operative interference; and if so, when it is proper to undertake it? The solution of these questions is fraught with difficulty, and must always be a matter of the most anxious consideration to the surgeon. It is not only that he knows that if the patient be left unrelieved, he must necessarily die; but that he is aware that the only means of relief, gastrotomy, is probably nearly as fatal as the disease for which it is undertaken; no case in which this operation has hitherto been performed for internal strangulation having recovered. But the difficulties that present themselves in the solution of the question are much increased by the great obscurity in diagnosing the cause of the obstruction, for in many cases it is absolutely impossible to determine with certainty whether it be dependent on ileus, or arise from mechanical causes; and by the fact that apparently desperate cases occasionally recover without operation. If, however, by attention to any of the points that have been pretty fully adverted to, it can be satisfactorily made out that there is an internal strangulation, and more especially if the intumescence occasioned by it can be felt, it will evidently be the duty of the surgeon to give the patient his only chance by the division of the stricture. With regard to the time at which this should be done, the only general rule that can be laid down is probably the conclusion arrived at by Mr. Phillips; that operation is justifiable when three or four days have passed without any relief from ordinary means, constipation being complete, and vomiting of fecal matters continuing.

Gastrotomy may be performed in the following way. The room being well warmed, the patient should be laid on a high table, his legs being allowed

to hang over the end of it, so as to afford a full view of the abdomen. The bladder having then been emptied, chloroform should be administered to the patient, the surgeon, taking his stand between the legs of the patient, proceeds to make the incision through the abdominal wall. If a tumour can be felt, the seat of obstruction in any way diagnosed, the cut must be made in a longitudinal manner directly over the seat of mischief, if there is evidence to show where the obstruction is situated, it had best be made in the mesial line. It must be carried through the abdominal wall until the peritoneum is reached; this must then be slit up by means of a sharp pointed bistoury guided by the fore-finger of the left hand. The constricted intestine will now probably protrude through the wound, curling over its edges; they must be drawn to one side, and be carefully supported by an assistant, who should press upon them with a soft towel, whilst the surgeon searches for the obstruction. This he does by very carefully and patiently tracing upwards the contracted and empty coils, which must necessarily be below the seat of obstruction, or by following downwards the dilated intestine. If there be a hernial constriction, he may divide the tumour which constitutes the stricture by means of the scalpel, or break it through with the finger; or he may withdraw, from the aperture in the omentum, the mesentery into which it had slipped, the constricted coil of intestine, and if it be a case of volvulus, the gut may be untwisted, as in a case of hernia, and operated. The intestines having been returned, the wound should be closed by the interrupted suture, and the application of some transverse strip of plaster; the patient must then have his knees bent over a pillow, and should be kept principally upon ice and barley-water. Opium must be administered, and the case generally treated on the ordinary principles of an abdominal wound.

Treatment of Chronic Intestinal Obstruction.—This must be conducted upon different principles. Here the great point is to remove the obstruction. With this view the rectum should be explored; and, if it is found to be blocked up by rounded masses of impacted feces, as may sometimes happen, these must be broken up and removed by means of an iron lithotomy scoop, and copious enemata administered. At the same time purgatives may be tried, and a drop or two of croton oil may be given. The constipation, however, arising from other causes, purgatives will induce vomiting, and will always considerably increase the patient's distress, and should not be repeated; the patient should be kept quiet in bed, have a nourishing diet, one leaving little residue is to be preferred, the best consists of beef-tea, eggs, and a small quantity of brandy, and the passage should be opened by enemata, and the introduction of the tube stomach-pump. If these means do not succeed, and if the obstruction is almost always the case in these chronic instances, be seated in or below the sigmoid flexure of the colon, the intestine must be opened at a point above the seat of disease. This may be required for acute as well as for chronic obstruction; for it may be observed that although, in the former, the obstacle is usually situated in the small intestine, yet it is occasionally met with in the colon. But in chronic obstruction it is almost always the large intestine that is affected. The operation required to give exit to the intestinal contents is of two kinds; in one the intestine is opened in the iliac fossa, by cutting through the peritoneum covering it. In the other it is opened in the left loin by cutting between the layers of the mesocolon, and thus opening it where it is uncovered by peritoneum.

The first operation, or *Littre's*, as it has been called, was proposed by the surgeon of that name, in 1710, who advised that in those cases the

Alexander of the colon should be opened from the left iliac region ; but it was not until the year 1776 that any operation of the kind was performed, when Fallore, a surgeon of Rouen, was the first to make an artificial anus on the adult, for relief of retention of feces ; this he did, not according to Littré's method, but by opening the cæcum from the right iliac region. Fine, of Geneva, in 1797, opened the transverse colon from the umbilical region, in a case of retention of feces produced by scirrhus of the upper part of the rectum.

Although these operations serve to fulfil the indication of relieving the retention of the feces, they are all defective in one most important respect ; for, as the peritoneum must in all of them of necessity be wounded, an intense and frequently fatal peritonitis is the inevitable consequence. It was to avoid this serious complication that Callisen, in 1796, proposed opening the colon from behind, in the left lumbar region, where it is not covered by peritoneum. He once attempted this operation on the dead body of a child ; but, failing in his endeavour to reach the intestine without wounding the serous membrane, he seems to have relinquished all further idea of it ; and it was subsequently rejected as impracticable by all writers on surgery who treated of this subject.

Amussat, at the time when he was attending the celebrated Broussais for that scirrhus affection of the rectum of which he ultimately died, was led to reflect on the resources that Surgery offers in similar cases ; and after making some experiments on the dead body, with the view of contrasting the merit of the different operations that have been proposed for the formation of artificial anus in cases of obstruction of the large intestines, he became convinced that the operation proposed by Callisen, if somewhat modified, was not only practicable, but safe. He soon had an opportunity of putting this opinion to the test of experiment in 1839, in a private case, at which he kindly invited me, then a student in Paris, to be present ; and since this time the operation has been performed at least nearly fifty times.

The following is the way in which Amussat's operation may be performed. A transverse incision is to be made two finger-breadths above and parallel to the crista ili of the left side, or rather in the middle of that space which is bounded by the false ribs above and by the crista ili below ; the incision should commence at the external margin of the erector spinæ, and extend outwards for about four inches. The spinous processes of the lumbar vertebrae, the crest of the ilium, and the last false rib, are the principal guides. The superior margin of the crista ili is, however, the safest of these ; and the transverse incision may be said to correspond to the middle third of this part of the ilium. After the skin and the more superficial tissues have been divided, the muscular layers are next to be incised as they present themselves ; if necessary, the external border of the quadratus lumborum may also be cut across. The dissection is then very carefully to be carried through the fine but firm layers of cellulo-adipose tissue, which lie immediately upon the intestine. When the patient is fat, these are loaded with adipose tissue ; when thin, they are semi-transparent and membranous, closely resembling peritoneum, for which, indeed, they may readily be mistaken. These layers immediately overlie the colon, which may usually be felt and seen to bulge through them. After their division, the colon will, in general, readily present itself, and may at once be recognised by its greenish colour and distended appearance (Fig. 402). The operation may then be completed by passing a tenaculum, or a needle armed with a strong waxed thread, into the most projecting part of the gut, and by this means drawing it to the surface of the wound, in order to prevent it from shrinking.

or sinking back when opened. It is now to be punctured with a large trochar or bistoury; and its contents having been evacuated, the sides of the



Fig. 402. Amussat's Operation.

the operation is proportionately difficult on account of the depth of cellular adipose tissue lying in front of the quadratus, which requires to be very carefully dissected through before the gut can be reached. This step of the



Fig. 403. Arrangement of Openings in Amussat's Operation.

operation will be much facilitated by dividing the deeper seated tissues in a crucial manner so as to give the operator more space. When the operation is practised on the dead body, it will be found on dissection that the following are the parts cut through. After the skin and cellular tissue, the latissimus dorsi will be seen divided towards the posterior third of the incision, and the obliquus externus in the anterior two-thirds of it; the obliquus internus and the transversalis, sometimes the quadratus lumborum, the cellulo-adipose tissue which immediately covers the intestine, and finally the colon itself, come into view. The colon is usually found a little in front of a point that lies midway between the anterior and the posterior spines of the ilium. After the more superficial incisions have been made, the surest guide will be the line of condensed fascia which forms the anterior edge of the sheath of the quadratus, as which lies between that muscle and the transversalis. This line may always readily be distinguished by its buff colour from the surrounding muscular structures. Very few vessels or nerves are wounded, as they for the most part run parallel to the line of incision; whereas, if the vertical incision of Callisen were adopted, they would necessarily be cut across.

Amussat's operation may also be called for in cases of cancer of the rectum, when there is perhaps but little or no distension of the gut, the object being to prevent the feces from passing over and irritating the ulcerated surface. In such cases, the operation is very difficult in execution, for, on account of the contracted state of the colon, that intestine recedes behind the quadratus lumborum, and the folds of peritoneum nearly surround or invest it; and it is so covered in by fat and cellular tissue that a very cautious dissection is required to expose it without wounding the peritoneum.

When we compare the different operations that have been proposed for the formation of an artificial anus, it will be found that Callisen's, as modified

opening in the intestine is to be fixed to those of the incision in the skin by four or five points of suture, as to prevent the contents of the bowel from being effused into the cellular tissue of the wound (Fig. 403).

It is of importance to draw the colon well forwards before opening it, in order to prevent its contents from being effused into the loose cellular tissue of the wound where they may set up considerable irritation and retard the union of the parts.

If the patient be very fat

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Amussat, is the one to which the preference must be given ; for by it alone the peritoneum is not wounded, and thus the inflammation of that membrane, which is a necessary and so often a fatal consequence of the other operations, is avoided. Beside this advantage, which is of the very greatest importance, Amussat's operation presents several other claims to our notice. As only one side of the colon can be drawn forwards, and not a knuckle of it, as would be the case if the small intestines were operated upon, it is evident that the spur-like process, which has been described by Dupuytren, must exist to a very small extent ; and consequently, if the artificial anus should ever become useless, the natural passage for the fæces having been re-established, it could readily be closed up. If, however, the peritoneum should be accidentally wounded in the attempt to reach the colon from behind, even then this operation would be preferable to that of Littré ; for, the cavity of the abdomen having been opened at its most depending part (in the recumbent position), the fecal matters would have much less tendency to be effused into it, than if it were opened in front. In respect of not wounding the peritoneum, this operation closely resembles that of puncturing the bladder above the pubes, and below the reflection of that membrane. There is, however, one important difference between the two operations, which may influence the result ; in the one case, as the patient lies upon his back, the urine has a tendency to stagnate in the wound, being obliged, in order to escape, to mount against its own gravity ; whilst, in the other case, the fecal matters find a ready exit from a wound situated in a depending part.

Cæsar Hawkins, in a paper published in the 25th volume of the *Medico-Chirurgical Transactions*, has collected and analysed 44 cases, in which an artificial anus has been formed by opening the intestine ; in 17 of these the artificial anus was made through the peritoneum, and in 27 behind that membrane ; but for various reasons, which are stated at length in the paper, Hawkins excludes 5 of the cases of peritoneal section, leaving only 12 to compare with 26 cases of operation behind this membrane. Of the former, he finds that 7 died and 5 recovered ; the recoveries amounting, therefore to only forty-one per cent. in the cases of this category ; whilst of the 26 cases where the peritoneum was uninjured, 10 died and 16 recovered ; the proportion of recoveries in the cases of this category amounting to sixty-one per cent. Though the large intestine was opened in all these cases, the operation was performed on the *right* side in 10 instances ; in 4 cases the right colon and cæcum were opened through the peritoneum, and of these all died ; whilst of the remaining 6, in which the right colon was opened behind the peritoneum, 4 recovered. The preference, therefore, as Hawkins observes, on the right side, is certainly due to the lumbar operation. It is remarkable, however, that in the operation on the *left* colon, the results are somewhat different ; for, of 8 cases in which this intestine was opened through the peritoneum, 5 recovered and 3 died ; whilst of 20 cases in which the lumbar operation was performed, 11 recovered and 9 died. Mr. Hawkins observes, that the inequalities of the numbers appear, however, to leave the question as to the mode of operating on the descending colon still undecided ; and that an operator is justified in selecting whichever situation he thinks best for the formation of an artificial anus on the left side of the body ; still, for the reasons that have already been given, I should very decidedly prefer Amussat's to Littré's operation. In those cases in which death has resulted from Amussat's operation, peritonitis does not appear to have exercised any material influence ; and the fatal result seems rather to have depended on the influence of previous disease on the constitution of the

patient, or on changes taking place in the diseased bowel, than on the operation itself, which appears occasionally to have been uselessly done at the extremity. We should, therefore, have less hesitation in performing the extraperitoneal operation in an early stage of those cases in which it is called for, than we should if the section itself were attended with any serious risk to the patient's life.

CHAPTER LXIV.

TAPPING THE ABDOMEN.—TUMOURS OF THE GROIN

TAPPING THE ABDOMEN.

THE abdomen often requires *Tapping*, either for ascites or of encysted dropsy. This operation, which is perhaps the simplest in surgery, may be performed as follows. The bladder having been emptied, the patient is seated at the edge of the bed or of a large chair, or if very weak lies on the side, under a broad flannel roller, split at each end to within six inches of the ends, passed round the body in such a way that the untorn part covers the front of the abdomen, whilst the ends, which are crossed behind, are drawn up by an assistant on each side, who must draw tightly upon them as the water flows. The surgeon then, seating himself before the patient, makes a small incision with a scalpel into the mesial line about two inches below the umbilicus, and through the opening thus made, he thrusts the trochar; as the fluid escapes, the patient often becomes faint, but this may commonly be guarded against by continuing to draw upon the bandage so as to keep up good pressure on the abdomen. After all the fluid has escaped, the aperture must be closed with a strip or two of plaster supported by a pad and bandage.

The incision through which the trochar is thrust need not enter the peritoneum, though if it do it matters little. The trochar itself must be of full size with a well-fitting cannula. Sometimes it is convenient to have one fitted with a stop-cock, to the end of which a vulcanised India rubber tube may be adapted, by which the fluid is carried quietly and without splashing into the pail destined to receive it. Should the particular character of the accumulation of fluid in encysted dropsy not admit of its withdrawal by an aperture below the umbilicus, the abdomen may be tapped in any other convenient situation, except in the course of the epigastric vessels.

TUMOURS OF THE GROIN.

Tumours of various kinds may develope primarily in the groin, or descend into it from the abdomen. They are of the following kinds—1. Enlargement of the Lymphatic Glands. 2. Abscess in or around those glands. 3. Abscess descending into the groin from the abdomen—Psoas, Iliac, Perinephritic, &c. 4. Varix of the Saphena Vein at its entrance into the femoral. 5. Aneurisms of all kinds. 6. Osteo-Aneurisms. 7. Cystic Tumours, bursal, and developing in the muscular structures. 8. Solid Tumours, as fatty, fibro-cellular, fibro-plastic, and fibroid. 9. Malignant Tumours, primarily developing in the soft structures in this region, extending into it from the bones, or secondarily from contamination of the glands. 10. Hernia of different kinds—inguinal, femoral, and oblique.

DIAGNOSIS.—In effecting the diagnosis of these various tumours, we must

first distinguish the pulsating from those that do not pulsate. The *Pulsating* must either be aneurism, osteo-aneurism, and cancers or abscesses with communicated pulsation. The diagnosis of these different forms of disease has already been so fully given at pages 589 and 734, that I need not enter upon it here.

The *Non Pulsating Tumours* are to be divided into two great classes, viz., the *Reducible* and the *Irreducible*.

The *Reducible Tumours* of the groin are either hernia, varix of the saphena vein, or abdominal abscess, presenting under Poupart's ligament. The diagnosis of these diseased conditions is given at p. 1013. These have all an impulse communicated to them in coughing.

The *Irreducible Tumours* of the groin have further to be divided into those that contain *Fluid* and those that are *Solid*.

The irreducible tumours containing *Fluid* are either abscess in or around the lymphatic glands, or cystic growths of various kinds. The diagnosis here is easy: the irregular hardened outline of glandular abscess, its rapid development, and softening from a previously indurated state, will distinguish it from the tense, clearly defined outline, smooth and elastic feel of the slowly developing and very chronic cystic growth. In irreducible hernia the impulse on coughing, and the peculiar signs characteristic of that disease, will prevent the possibility of error in diagnosis.

The *Solid* tumours in the groin may either be simple or malignant. The history of the case, the feel of the tumour, the rapidity of its progress, the extent of contamination of neighbouring parts, and the other signs that serve as diagnostic differences between simple and malignant growths, will enable the surgeon to effect the diagnosis with sufficient accuracy.

The *TREATMENT* of many of these tumours, such as abscess of various kinds, aneurism, varix, and hernia, has already been so fully considered in the various chapters devoted to these diseases, that I need not enter upon it here. But the question of operating for the removal of *cystic and solid tumours* of the groin, is one that presents several special points for consideration. These are, the relations of the morbid mass to the femoral vein, to the femoral artery, and to the abdominal cavity. If the tumour lie upon or compresses the femoral vein, oedema of the foot and leg will be the result; and, should the compression have been prolonged and very chronic, this oedema may assume a semi-solid character, so as to occasion a condition of the limb closely resembling elephantiasis. Although an intimate relation such as this between the tumour and vein would obviously inculcate the necessity for extreme caution, it need not necessarily preclude the idea of operating for the removal of the tumour, which may possibly be altogether above and unattached to the sheath of the vessels. I once successfully removed a tumour of many years standing of a nœvoid and lipomatous character, in which the limb was in a state of spurious elephantiasis from compression of the femoral vein, but in which the vessel was not involved in the growth. If the femoral artery be compressed to such an extent as to interfere with the circulation through the lower part of the limb, it will most probably be found that the tumour dips under or surrounds the vessel so as to render removal impracticable. The mere overlying of the artery by a freely moveable mass, without any compression of the vessel, need not preclude operation. The growth figured p. 822, was of this kind. The connection of the tumour with the abdominal or pelvic cavities under Poupart's ligament, or through the obturator foramen, must be carefully examined. Should this exist, or even be strongly suspected, operation is necessarily not admissible.

CHAPTER

DISEASES OF THE LARGE IN

CONGENITAL MALE

Congenital Malformations of the anus—unfrequent occurrence, and are of considerable importance, as they must necessarily be the cause of asphyxia. They may exist in various degrees, which may be arranged under the following heads.

NARROWING AND PARTIAL CLOSURE OF THE ANUS.—The anus is pervious, but not sufficiently so to allow of the stool being expelled, the contraction usually merely forcing it into the rectum. In some cases the obstruction appears to depend upon a partial closure of the orifice, in others upon an imperfect septum.

Treatment.—This consists in notching the perineum with a pointed bistoury, and then introducing a bougie of the proper size, to which it must be kept.

COMPLETE CLOSURE OF ANUS.—The anus is closed by a membranous septum stretching across it, in the middle line, and a slight depression, through which the stool may be seen, and on which an impulse can be felt. This is the most common form of malformation that is met with.

Treatment.—In this variety an incision is made along the middle line, and this again causes the meconium to freely escape. The four corners of the septum are removed, and the aperture kept open by the use of a bougie.

OCCLUSION OF RECTUM ABOVE THE ANUS.—The anus may remain open; but, at a distance from its aperture, the rectum will be found closed by a membranous septum stretching across it. This is a variety of malformation, as in it the infant will be born with obstruction, and yet, on examination, the anus will be found formed, and thus the surgeon may be misled. He will, however, detect it by introducing his finger into the anus. In several cases of this kind, to me, I have opened the septum by puncturing it with a needle, after the lapse of a few days, dilated the rectum with a bistoury, the cases ultimately doing well.

COMPLETE ABSENCE OF ANUS.—The anus is blocked up by a dense mass of fibro-cellular tissue, an inch in thickness, above which the rectum is found.

Treatment.—An incision about an inch long is made, from the point of the coccyx forward, down until the gut is reached; this may be done, and the meconium allowed to escape. If the cut is made, a plug of lint merely interposed between the rectum and degenerate into a fistulous opening, the stool will escape with difficulty; and, as this track

case, the probability is that the irritation set up along it by the intestinal matters will ultimately prove fatal to the child. Indeed, it commonly happens in these cases that death results in a few days, from irritation occasioned by the absorption of the excreted fluids. In order to obviate this source of danger, Amussat thought of bringing down the mucous membrane of the bowel to the anal orifice, and fixing it there by sutures, so as to afford the meconium a mucous canal to pass through, and thus to prevent the diffuse inflammation which is apt to take place in the cellular tissue of the pelvis, by the contact and absorption of the effused matters. In many cases it is by no means easy to do this, but it should always be attempted, as I believe the whole safety of the child depends upon this being carried out. For some considerable time after the operation, the aperture should be kept dilated by means of bougies; a gum elastic or pewter tube, through which the feces are allowed to escape, may be fixed in the part.

CLOSURE OF ANUS WITH ABSENCE OF RECTUM.—The anus may be closed and the whole of the rectum absent; the intestine (colon) terminating in an expanded pouch, situated high up at the brim of the pelvis. A case of this kind differs from the last only in the extent of the occlusion, and cannot indeed be distinguished from it until the surgeon has made an incision in the wall of the anus, and has failed to reach the gut at the usual distance from the surface.

Treatment.—In these cases three courses present themselves to the surgeon.

1. The colon may be opened in the left iliac region; 2. It may be reached in the left lumbar region; and, 3. An opening may be made into it through the perineum.

1. *Iliac Incision.*—The only *advantages* that the iliac incision, or Littre's operation presents, are, that it is an operation easy of performance; and that, whether the surgeon reach the colon or not, he is certain to hit upon some part of the intestinal tube which may be drawn forwards and opened.

The *objections* to this operation are, the inconvenient situation of the artificial anus; the great danger that must necessarily result from wounding the peritoneum; the chance of not finding the sigmoid flexure; and, as has often happened, of being obliged to open that portion of the small intestine which first presents itself.

The *mortality* after this operation is very great. Amussat states that, of twenty-one children thus operated on, only four ultimately recovered; and it is worthy of remark, that all the successful cases occurred in the town of *Genoa*.

2. *Lumbar Incision.*—The lumbar incision, or Amussat's operation, has now been several times successfully practised on imperforate children.

The *advantages* of this operation consist not only in the artificial anus being situated at a more convenient spot than in Littre's operation, but more especially in the possibility of opening the colon in this situation without wounding the peritoneum.

The *objections* to this operation, as applied to imperforate children, lie in the frequent coexistence of malformation or malposition of the colon with absence of the rectum, and in the impossibility in many cases of determining, before proceeding to operate, whether the anus is only occluded by a membranous septum, or whether the rectum is absent as well. If it could be ascertained beforehand that, though the rectum be absent, the descending colon occupies its normal position in the left lumbar region, I think it probable that the lumbar incision would be attended with less danger than any other operation that could be practised; but in the absence of this

knowledge, it would scarcely appear to be as the colon might not be found, and the a dense membranous septum.

3. *Perineal Incision.*—The perineal incision is the natural situation of the anus, and of be successful in all those cases in which the an being present. It is in those cases only in of the rectum that this operation is difficu in its results. The dissection requires to siderable depth along the mesial line; the sacrum and coccyx for his guide, and, bea bladder and large vessels in the neighbe search of the gut, which may be found at surface. Danger of wounding the bladde may be materially lessened by emptying pubes before commencing the operation. which I have operated, it was necessary t one and a half or two inches before the account of the narrowness of the wound a relations of the parts, is not an easy matter. proceeding to operate, that the rectum is al for the bowel in the lumbar region. But, ascertaining, before making his incision, w three inches from the surface, he must ob obtain the necessary information; and if o depth as to pass beyond the levator ani in this situation, a great portion of the immed have been incurred, and few would think operation unfinished, and expose the child the colon in the lumbar region. Yet, if h venture, and have not encountered the bow open the intestine through the abdominal fate. In this alternative, Amussat's operatio actually been done, and with success. I sa Mr. Bryant, a young gentleman, eight years c on in Mexico for congenital absence of the had first been made in the perineum, but, colon was opened in the left lumbar regio well nourished, had no great trouble with covered with a truss pad, and only suffer prolapse of the mucous membrane. Ther action in the muscles about the orifice, by

There is one point in connection with th of much importance especially to attend, n result of the operation, but as regards the I mean the bringing down of the mucous it to the lips of the external wound. Unles between the termination of the gut and the degenerate into a fistulous canal; which, lik to contract, and will be a source of endle and to the patient. If the mucous mem fixed to the opening in the integument, the removed, and the patient will be saved al the passage of the meconium over a variou

This, however, can only be done when the intestine terminates at a short distance from the surface. If the perineal incision be two or three inches in depth, there will be little probability of the surgeon being able to bring the intestine down to such an extent. In the case that I have related I attempted to do so, but found that the gut was too firmly fixed to be moved by any traction that it would have been safe to have employed.

ABSENCE OF ANUS: OPENING OF RECTUM INTO OTHER CANALS.—The anal orifice may be absent, and the gut may open into one of the neighbouring mucous canals, as the vagina, the urethra, or the bladder. In such anomalous cases there is usually, I believe, but little to be done, except to restore the anal orifice if possible; but, if this be impracticable, to make a lumbar orifice, and then to take the chance of the other preternatural communication closing. This it will sometimes do; and cases have occurred in which, although the whole of the meconium with flatus had escaped *per urethram*, yet, on opening the rectum, the abnormal communication seemed gradually to close, the feces being directed into their proper channel. In a case in which I was once consulted, there was imperforate anus and rectum, and the bowel protruded as a red, fleshy tube, about four inches in length; from the end of which, in the anterior abdominal wall, just below the umbilicus, and immediately above an extroverted bladder, the meconium escaped. In such a complicated malformation, Surgery could evidently do nothing.

STRICTURE—SIMPLE AND MALIGNANT.

Stricture may occur in any part of the large intestine, but with very varying degrees of frequency in different parts of that gut. Excessively rarely met with in the transverse, of unfrequent occurrence in the descending colon, it becomes more common in the sigmoid flexure, and very frequently occurs at about the junction of this portion of the colon with the rectum. In the rectum itself it is most commonly found either at the upper part, from four to six inches above the anus, or else a little above that aperture.

It is of two kinds; the Simple, consisting of mere thickening of the bowel, with fibrous degeneration of its coats and contraction of its canal; and the Malignant, dependent on cancerous degeneration of, or formations in the bowel.

SIMPLE OR FIBROUS STRICTURE, though occasionally occurring in the transverse or descending colon, is most frequently met with at the junction of the sigmoid flexure and the rectum, or at the upper part of this gut, from four to six inches from the anus. Stricture of the large intestine commonly occurs in elderly people, and with special frequency in women. Not unfrequently a very tight annular stricture is found in otherwise healthy subjects, chiefly in young women, at the lower part of the rectum, about an inch and a half from the anal orifice; appearing almost as if it were the remains of a septum, or a thickened annular fold of the mucous membrane in this situation.

Symptoms.—The symptoms of stricture of the rectum consist at first of some difficulty in defecation, the patient being obliged to strain at stool. The feces will also appear to be flattened or narrowed, and in many cases, more especially as the stricture advances, are passed in the form of small scybala, with occasionally a kind of spurious diarrhoea, consisting of the passage of the more fluid intestinal contents, whilst the solid matters are left behind. At the same time there is very commonly pain in defecation, and the occasional passage of some mucus or blood; and dyspeptic symptoms, with flatulent distension of the abdomen, are apt to come on. If the stricture be within four or five inches of the anus, it may be reached with the

finger, and its precise situation and diameter ascertained. If above the point, it must be examined by the introduction of a well greased bougie, attention being paid to the curve which the rectum makes from side to side as well as from before backwards. In introducing a bougie in order to ascertain the presence of a stricture above the upper end of the rectum, but little information can be gained in many cases, as the point of the instrument is apt to hitch in folds of the mucous membrane, or opposite the peritoneum of the sacrum; and thus, its onward passage being prevented, the appearance of constriction may present itself, which in reality does not occur, and unless care be taken the mucous membrane may actually be lacerated, and the instrument forced through it into the peritoneal cavity. In other cases, the bougie will appear to pass, when in reality its point, meeting with an obstruction, curves downwards into the rectum.

The *Progress* and termination of a simple stricture vary in different cases. In some the contraction of the stricture may go on increasing, until at last complete occlusion takes place, with retention of feces and all the symptoms of obstructed bowels. This condition usually comes on slowly, and, after the obstruction is complete, life may continue for several weeks, but in some instances the obstruction appears to take place rather suddenly, and with all the symptoms of acute intestinal strangulation, death occurring in a few days. Abscess occasionally forms in the neighbourhood of the stricture; and, passing down into the pelvis, may burst either into the ischio-rectal space, or into the vagina, or may present upon the nates. The discharge of pus from this source, as well as from the mucous membrane lining the stricture, which falls into an ulcerated state, may induce extreme emaciation and hectic, to which the impairment of nutrition consequent upon the disturbance of digestion adds materially. In some cases peritonitis will at last ensue, either in consequence of ulcer or abscess communicating with the serous cavity, or else from the extension of the irritation outwards.

Treatment—The treatment of simple stricture of the rectum must be conducted on the principle of dilating the canal at its constricted point. If this be within reach of the finger, the dilatation can be readily carried out. If it be above the upper part of the rectum, and the stricture be tight it is extremely difficult to introduce the proper instruments with certainty. When the stricture is low down, so that the end of the finger can be introduced into it, it may readily be dilated by introducing a rectum bougie every second day, and gradually increasing the size of the instrument. If the stricture yield but slowly, and be very tight and undurated, I have found it a convenient plan to introduce a sheathed probe-pointed instrument into it and to notch it towards its posterior aspect, where this may be done without danger to the peritoneum. A tent of compressed sponge should then be introduced, and left in for twelve hours. On its withdrawal, bougie may more readily be passed; or the dilatation may be carried on by means of tents of compressed sponge. When the stricture is above the reach of the finger, a good deal of management will be required to make the bougie enter it. This is best done by laying the patient on his left side, and using a moderate-sized wax or elastic bougie, which must be passed without the employment of any force. When once the surgeon has introduced one, others can readily be made to follow in the same track. The great danger in introducing a bougie high up, is to mistake the obstruction offered by a point coming into contact with one of the valvular folds of mucous membrane that occur in this situation, for that of the stricture, and, by pushing on the instrument, to perforate it—an accident that would probably

crasion fatal peritonitis. During the introduction of bougies, the bowels must be kept regular by means of lenitive electuary, and the occasional use of emollient enemata. If much pain or irritation should be occasioned by their presence, opium should be administered internally or in the form of suppositories. Though a simple stricture of the rectum may be much relieved by the use of bougies, it is seldom, I think, cured by this means; there being a great tendency in it to contract so soon as the treatment is discontinued.

If complete obstruction occur, an endeavour should be made to relieve the patient by the use of enemata of gruel and linseed-oil, and the strength should be supported by a diet that is nourishing, at the same time that it leaves little or no solid residue; the bowels may eventually act after a considerable lapse of time, the stricture apparently giving way. In a case which I attended with Mr. Powell, and to which reference has already been made, the stricture gave way after obstruction had lasted for about five weeks, some hardened feces with bloody mucus being discharged, which were speedily followed by abundant feculent motions. Should the obstruction, however, continue, and the patient consequently be in imminent danger of death from this cause, the intestine should be opened, if possible, by Amussat's operation, performed in the way already described (p. 1029). This may require to be done either on the right or the left side, according to the seat of stricture. In the majority of instances, this will be situated below the descending colon, so that relief may be given by opening this intestine in the left loin; but if it be impossible or even very difficult to determine the precise seat of the obstruction, the operation may as readily be performed in the right lumbar region. In those rare cases in which the stricture is seated in the transverse colon, there would probably be considerable distension of the right loin, without any corresponding enlargement of the left; under these circumstances, the proper plan would be to open the cœcum.

CANCER AND MALIGNANT STRICTURE.—Cancer of the rectum usually occurs in the form of degeneration or infiltration of the substance of the wall of the gut, giving rise to considerable induration and contraction of the bowel. In other cases, a flat cauliflower growth springs from the inner surface of the intestine, being hard, nodulated, and presenting all the ordinary characters of scirrhus, or fibro-plastic; sometimes it is somewhat pedunculated, so as to resemble a hemorrhoidal protrusion. Lastly, a scirrhus tumour may form in the cellular tissue external to the rectum, and at last press upon and implicate the gut.

Most usually cancerous disease is seated from three to five inches above the anus, and may implicate a considerable portion of the bowel, extending upwards rather than downwards, and giving rise to considerable induration and contraction, with complete occlusion of the interior of the gut.

Symptoms.—The symptoms of cancer of the rectum are pain and weight in the gut, with a sensation as if the bowels had not been completely relieved, together with the discharge of mucus, blood, or pus, and some flattening of the feces. On exploring the parts with the finger, the lower portion of the rectum will usually be found considerably expanded, whilst the tip of the finger will come into contact with the contracted, hardened, and rugged scirrhus mass. The patient experiences most suffering during defecation, in consequence of the passage of feces over the raw and ulcerated surface. This pain is not confined merely to the diseased part, where the sensation is of a hot and burning character, but usually radiates round the loins and down the thighs, and is so severe, that the patient looks forward

to each action of the bowels with the greatest pain, and it as long as possible. The whole nervous system is continually recurring suffering; the coagulable spirits are depressed; sleep and digestive condition is indeed truly miserable, between the times when the bowels act, on the one hand, and when they do not, on the other; and in many instances the patient dies together with the constitutional cachexy, and the system with the cancerous matter. The pain is much increased by the formation of fistulae, either of the bowel, and communications between the bowel, as the vagina, bladder, or urethra, with the rectum, in other instances, though more rarely, death occurs in the case of simple stricture.

Treatment.—The treatment must necessarily be palliative, opium being required after each action of the bowels to relieve distress. Little good can be expected from any other remedy, only irritates the disease, and would tend to the application of caustics, such as potassa fusa, is of no advantage, as only a superficial slough could be produced, at very serious risk to the patient, and it is not to be anticipated. Amussat has proposed to crush and break down the tumour with the finger and forceps; but from such a procedure much is to be anticipated. The recommendation of excision by Lafranco and other French surgeons, is not to be considered good surgery; as it is impossible to extirpate the tumour without either laying open the peritoneal cavity, or the risk of profuse hemorrhage, which could scarcely be avoided, fail in affording the requisite relief, and the patient dies of constitutional irritation during defecation. In several instances much relief of suffering has been effected by an artificial anus in the left lumbar region, but rather in the view of saving life, but rather in the view of lessening suffering by preventing the exertion required to attend the passage of the feculent matter or gas. In several instances much relief of suffering has been effected by this procedure.

CANCER OF THE ANUS.—This is not a very common disease, it usually occurs in consequence of chronic inflammation, and involving the margin of the anal opening. In the early stage, it is usually in the form of epithelioma, just as it does at other mucous surfaces. If detected in the early stage, it might admit of cure, in a more advanced period of the disease, it is not to be removed with any prospect of success, in such cases the only remedy is removing the whole of the structures implicated.

FIBRO-PLASTIC TUMOUR of the rectum, is a very common disease, large and somewhat pale tuberoso masses, which may protrude through the anus, or even protruding through the anus, and is characterised by local symptoms as characterise cancer of the rectum, less intense. In such cases as these the tumour, be removed by double whipcord, by the means of this instrument, I have removed tumours of this kind nearly as large as the largest, but the patient will get relief.

POLYPI sometimes form in the rectum, constituting large pendulous tumours of a fibro-mucous character; they may most conveniently and safely be removed by the application of a ligature to their neck.

RECTAL FISTULÆ.

Fistulous openings occasionally occur between the rectum and the bladder in men; or between this gut and the vagina in women.

RECTO-VESICAL FISTULÆ are not of common occurrence, and usually result either from organic disease of a cancerous character, establishing a communication between the rectum and the bladder; or from a wound of the gut during the operation of lithotomy. In these cases the urine escapes *per anum* in greater or less quantity, occasioning constant irritation or excoriation, with a sort of liquid diarrhoea; and the wet state in which the patient is kept by the dribbling of urine gives rise to an offensive ammoniacal odour about him. If the communication between the rectum and bladder be a free one, feculent matter and flatus get admission into the urinary organ, and escape from time to time by the urethra; perhaps even more abundantly than the urine does *per anum*. This is especially the case when the fistula is carcinomatous; and it is remarkable how little irritation is often set up by this admixture of feces with urine in the bladder. The fistulous aperture in the rectum can always readily be detected by passing the finger into the gut, or examining its interior with the speculum ani.

Treatment—If the disease be cancerous, nothing can be done in the way of treatment beyond keeping the parts clean; but if it be traumatic in its origin, of small size, and more especially if it be recent, its closure may not unfrequently be accomplished by touching it with the nitrate of silver, or a red-hot wire through a speculum ani. In these cases, the platinum loop made red-hot by the galvanic current, according to Marshall's plan, might advantageously be employed. If, however, the fistula be of old standing, and the aperture large, cauterisation will probably not succeed; and then perhaps the only mode of treatment that can be adopted will be to introduce a grooved staff into the urethra, and cut through the sphincter upon this, thus laying the parts into one, and converting the anal into a perineal fistula. By keeping the catheter in the bladder, and emptying this, granulations will be allowed to spring up, and deep union be accomplished.

ENTERO-VAGINAL FISTULA.—It has happened that a communication has been set up between the small intestine and the vagina, an artificial anus in fact forming in this cavity. These cases, however, are very rare, and may indeed be looked upon as incurable; for though some of the French surgeons, as Roux and Casamayor, have endeavoured to establish, by a deep and difficult dissection, a communication between the small and large intestine, the operation, as might have been expected, has proved fatal.

RECTO-VAGINAL FISTULÆ are usually the result of sloughing of the posterior wall of the vagina, in consequence of some undue pressure exercised upon it during parturition. They are of two kinds; viz., the simple, and those complicated with more or less extensive laceration of the perineum. The size of these fistulous openings, when uncomplicated with rupture of the perineum, varies greatly; in some cases there is merely a small perforation, in others there may be loss of the greater portion of the posterior wall of the vagina. Whatever their size, they are necessarily sources of very great discomfort and annoyance, both physical and mental, to the patient. The recognition of the disease is of course at once made; the escape of the feces and flatus into the vagina being obvious, and digital or ocular examination

through the two-bladed speculum at once detecting the seat and extent of the aperture. As there is just the possibility of the communication existing between the vagina and the small intestine, it may be useful to bear in mind that, in this case, the feculent matter that escapes has been found to be yellowish and less stercoraceous than when the rectum is opened.

The Treatment will vary according as the fistula is simple or complicated with lacerated perineum.

Simple uncomplicated Recto-Vaginal Fistula, if it be small and recent, may occasionally be closed by attention to cleanliness, at the same time that its edges are touched with the nitrate of silver, a hot iron wire, or the platinum loop. If it be very large, the greater part of the posterior wall of the vagina having been destroyed, it will probably be incurable; but even here the patient should not be left to her fate, and some operation should be attempted which may lessen its size, even if it do not completely close it. The kind of fistula which is here most commonly met with usually consists of a circular aperture, that readily admits the point of the finger, as it is situated just above the sphincter ani. The operation for the closure of a recto-vaginal fistula of this kind consists, after emptying the patient's bowels by purgatives and an enema, and the bladder by the catheter, in introducing a duck-billed speculum into the vagina, and freely paring the edges of the aperture. As the fistula is always low down, this is readily done by placing the patient on her back, and tying the hands and feet together, as in lithotomy. The vaginal mucous membrane should be dissected off towards the fistula. The next point is to bring its edges into apposition, in a direction transverse to the axis of the vagina; and in doing this, the recommendation made by Copeland and Brown, of dividing the sphincter ani, should always be acted on, as it is a most important auxiliary to the success of the operative procedures that are required; for, as there is always loss of substance in these fistulae, there is necessarily a tendency to tension on their sides when any attempt is made to draw them together; and it is also of importance that any muscular movement about the parts in the neighbourhood of the fistula should be arrested, as this might otherwise break down union after it had taken place between the edges. The sides of the fistula must then be drawn into apposition by silver sutures introduced by means of the hollow needle. I have generally found that these sutures are most easily introduced if passed *from above downwards*—the mucous membrane being then drawn upon by the needle, which more readily transfixes it than if it is introduced from below upwards, when it is left to push the membrane before it. The wires are then passed across the fistula and out through the vaginal mucous membrane, half an inch beyond the freshened surfaces, care being taken not to include the rectal mucous membrane. They may then be twisted, or brought through a leaden plate and clamped by shot. The success of the procedure depends not only on the proper completion of the steps of the operation, but greatly on the after-treatment. This should consist in the administration of opium, to prevent the bowels from acting for ten or twelve days; indeed, until firm union has taken place between the edges. They may then be moved by means of laxatives and oleaginous enemata carefully given. During the treatment the parts should be disturbed as little as possible, the patient lying on her side with a gum catheter tied in the bladder. The parts should be well syringed twice a day with cold water. The patient must be kept upon a very moderate diet, and the stitches may be left in for eight days, when they must be cut out and carefully removed. Should any point of the fistula not be closed, the application of the nitrate of silver may induce proper union of it.

If, as very commonly happens, the *Recto-Vaginal Fistula* be complicated with *lacerated Perineum*, the operation for that condition, described at p. 412, must be performed, and the edges of the fistula, being deeply pared, brought together at the same time. Sometimes in these cases it happens that the perineum unites, leaving an aperture above this in the recto-vaginal septum: if this aperture be but small, it may be closed by its edges being touched from time to time with the actual cautery; if it be large, so as to allow the introduction of the finger, I believe that it is generally useless to attempt to close this aperture by itself; but the perineum should again be divided, and the whole operation repeated.

ULCER AND FISSURE OF THE ANUS.

This disease, though trivial in point of size and in its pathological relations, is of great practical importance, on account of the excessive local pain and great constitutional irritation to which a patient labouring under it is often subject. Ulcer and fissure commonly exist together in this situation, though it by no means unfrequently happens that the two conditions occur separately. The ulcer is usually of small size, seldom larger than a silver threepence, of a circular or a longitudinal shape, situated between the folds of the mucous membrane in the upper part of the anus, or rather the lower part of the rectum, just above the ring or ledge formed by the sphincter, and is usually met with towards the posterior part of the gut on one side of, or opposite to, the point of the coccyx. Occasionally more than one ulcer exists in this situation. If a fissure accompany the ulcer, it commonly leads from this across the face of the sphincter to the verge of the anus; but in many cases one or two fissures, sometimes even three or four, exist without any ulcer. The fissures are usually slightly indurated and cord like, extending merely through the mucous membrane, scarcely, if at all, implicating the deeper structures; and not unfrequently their external termination is concealed by a small red pile or flap of integument.

The existence of the ulcer may usually be determined by exploring the rectum with the finger, which, if practised in these examinations, will detect a small, soft, and velvety patch at the diseased spot; on touching thus the patient will usually complain of acute and burning pain. In some cases the



Fig 404.—Anal Dilator



Fig 405.—Speculum Ani.

ulcer may be brought into view by examining the rectum with the speculum ani, as here delineated (figs. 404 and 405). The fissure may always readily

be detected by everting the mucous membrane of the anus, and by turning up or turning aside the pile that covers the lower end of the crack. In this examination, it will usually be found that the sphincter is in a more or less spasmodically contracted state, admitting the finger and instrument with difficulty.

Symptoms.—The symptoms of ulcer or fissure in the anus are very characteristic. The patient complains of pain, usually of a severe burning character, on the passage of a motion, especially if a hard one; occasionally it occurs at the time of defecation, but more frequently commences a few minutes afterwards, and continues from half an hour to several hours. The pain is very severe, and peculiarly wearing and burning; it is generally most felt opposite the sacro-iliac articulation, but not unfrequently radiates across the pelvis or down the thighs. In many cases it produces a good deal of continued irritation about the genito-urinary organs, giving rise to synchysis or spasmodic stricture; a frequent desire to urinate, tenderness about the prostate, and seminal emissions. The pain is sometimes so severe that the patient avoids defecation as long as possible, and even abstains from it with the view of lessening the necessity for the frequency of this act. Very commonly in women, the pains produced by the rectal disease are attended or occasioned by uterine irritation; and in both sexes they may, after a time, become continuous, and be attended by a good deal of constant uneasiness sitting, so that the patient is obliged to raise the affected hip. There is often a discharge of a streak of pus or blood on the faeces, and commonly a good deal of mucous exudation, with some tenesmus on defecation, but in many instances these symptoms are altogether absent, and the patient never feels any local inconvenience except from the pain.

The constitutional irritation is often very great, the nervous system generally sympathising with the local mischief. The countenance is pale, anxious, careworn, and the patient's expression is indicative of constant suffering.

Causes.—This affection most commonly occurs in women, especially in those of an hysterical temperament and weakly constitution. When met with in men, it is most frequently seen in enfeebled, cachectic, and debilitated subjects, and appears to be the result of a broken state of health. In persons who have been the subjects of the chronic dysentery of hot climates, I have several times noticed a peculiar form of patchy ulceration within the rectum, of an extremely irritable and very intractable character. I have in several instances observed it in women to be of a syphilitic nature, and in such cases it is situated generally towards the side or the anterior part of the anus.

Treatment.—The treatment of fissure or ulcer of the anus, when the disease is met with in the early stages, may sometimes be successfully conducted by the application of nitrate of silver to the fissure, and the use of an astringent suppository. I have found a very excellent and useful suppository in this and many other painful affections of the anus to be composed of 2 grains of extract of belladonna, 2 grains of the acetate of lead, and 1 of tannin, made up to a proper consistence with a little suet. This may be introduced into the rectum every night and allowed to dissolve there, the bowels should at the same time be kept gently open with castor oil, or the lenitive electuary. In those cases in which the disease has been of long standing these means will not suffice, and it becomes necessary to have recourse to a very simple operation to effect a cure. This consists in turning the affected mucous membrane through the ulcer or fissure, with pressure on some of the subjacent fibres of the sphincter muscle, by which the part is set at rest, and cicatrization speedily takes place. The relief after the operation

is usually immediate; indeed, after its performance, a patient who has been suffering severely for months or years, will often get complete and almost instantaneous relief. The merit of introducing this plan of treatment for the cure of ulcer and fissure of the anus into surgical practice is due to Sir B. Brodie. Boyer had previously recommended that the sphincter should be cut completely across, in order that its action might be paralysed; but Sir B. Brodie found that the ulcer could be made to heal as readily by the limited incision above mentioned. The operation is readily done by introducing the left fore-finger into the rectum, guiding along it a probe pointed bastoury, and then cutting downwards and outwards, carrying the knife about the eighth of an inch in depth. The section may either be made through the ulcer and fissure, or on each side of the coccyx. It is doubtless better, when practicable, to cut through the diseased structures, though it is not necessary to do so; and it is always better to make an incision on both sides of the sphincter, so as to be sure that the muscle is set at rest. No dressing is required after this operation; but, if the incision do not readily heal at the end of a fortnight or three weeks, it should be touched from the bottom with the nitrate of silver. The patient's bowels should be well opened before the operation, and a dose of castor-oil may be given on the second or third day after it. During the process of cicatrisation it will often be advantageous to give iron, and to put the patient on a very nourishing diet.

Spasmodic Contraction of the Sphincter Ani is usually associated with fissure or ulcer of the anus; but occasionally it occurs without this complication, and in all cases it may be connected with a neuralgic condition of the part. In hysterical women, this neuralgia and spasm are especially apt to occur; though it is not improbable that in many of the so-called cases of neuralgia of the anus, some positive disease, such as a small ulcer or fissure, may be detected on close examination, as I have had several occasions to verify.

The Treatment of spasm of the sphincter, whether associated with neuralgia or not, consists in the employment of local sedatives, enemata, and laxatives, with, if necessary, the division of a few of the muscular fibres, together with the mucous membrane.

ABSCESS AND FISTULA.

ABSCESS not unfrequently occurs in the vicinity of the rectum and anus. It may either be superficial, being confined to the muco-cutaneous structures, and presenting the ordinary characters of acute subcutaneous abscess; or it may be deeply seated, forming in the ischio-rectal fossa. It is these rectal abscesses that are of most practical importance. They may be of two kinds—*Acute and Chronic*.

Acute Ischio-rectal Abscess.—This forms deeply in the fossa, with throbbing, shooting, and stabbing pains through the anus, rectum, and perineum; on examination, a hard brawny substance may be felt in the cellular tissues by the side of the gut, either by examination from without, or by exploration through the rectum, which speedily softens, and will, unless an outlet be made for it, either burst externally, or into the cavity of the gut, or both ways. This acute form of abscess usually occurs in persons of otherwise strong and healthy constitutions.

Chronic Ischio-rectal Abscess, on the other hand, occurs insidiously in persons of cachectic, broken, or phthisical constitutions. Without much pain or local inconvenience, it forms a collection of pus, which is usually limited to one side of the ischio-rectal fossa, but in other cases acquires con-

siderable magnitude, denuding the gut to a considerable extent, in the almost surrounding the rectum, and then spreading widely on the outside of the hip, presenting all the ordinary characters of a chronic abscess. The mass of purulent collection may form in this as in any other situation in the body, as the result of congestion or of some local irritation. I have seen it follow kicks, blows, or bruises of the lower part of the body, or the consequence of the lowering of the vitality of the mass of cellular and fatty tissue on the ischio-rectal fossa by weakly persons sitting on a cold stone or standing for a long time on the ice or snow. In other cases the abscess appears to originate around the prostate, and an abscess forming in this situation may bud its way down by the side of the rectum. Mr. Keen attributed these abscesses, and the consequent fistulae, to perforations of the mucous membrane of the gut, and although I think he exaggerated the frequency of this mode of production of the abscess, yet there can be no doubt that, in some instances at least, it occurs as the result of perforation of the gut; either by ulceration from within, by the formation of a tumor, or by some foreign body, as a fish-bone, transfixing it, and thus inducing inflammatory action in the cellular tissue outside the rectum.

Treatment.—In the treatment of these abscesses, the principal point to be attended to is to prevent the extensive denudation of the gut. In doing this the abscess must be opened, so soon as the formation of pus can be ascertained to have taken place, by making a free, and, if necessary, a deep incision into the ischio-rectal space by the side of the bowel. Unless this is done, it may either burst into the interior of the gut, or spread away upon the nates, and then give way. The pus that is let out of these abscesses is always extremely offensive, even though not mixed with any feculent matter; the near neighbourhood of the bowel appearing to determine a change in it that renders its smell peculiarly stercoraceous. After the evacuation of the abscess the patient feels easy, and thanks that air is vented, the discharge gradually lessening and the cavity contracting; but it does not close, and a fistula will be left, which continues to exude a thin watery pus, in which feculent matter, perhaps, accumulates from time to time, giving rise to fresh outbreaks and extensions of the disease.

FISTULA IN ANO.—The sinus left by the contraction of the cavity of an ischio-rectal abscess constitutes a *fistula in ano*; an affection that has attracted a good deal of attention from the frequency of its occurrence, and from the difficulty of curing it without having recourse to operation.

Extent.—Some fistulae are very limited, being merely the sinus left in the submucous cellular tissue of the anus after the bursting of a superficial abscess in this situation, extending to a short distance up the gut inside the sphincter. This form of fistula constitutes, however, a kind of spurious variety of the disease; for the true fistula in ano is outside the sphincter in the surrounding cellular tissue, extending always as high as the upper margin of that muscle, and frequently stretching to a considerable distance up the side of the gut. Most frequently the lower and external aperture of the fistula is single, and is situated by the side of the anus in the ischio-rectal fossa, just beyond the sphincter; but not unfrequently the aperture is in the perineum, or posteriorly in the coccygeal region. Occasionally there is a fistulous opening on each side of the gut; or several openings may exist, and then sinuses extend from these outwards to a considerable distance, undermining the integuments about the buttocks, even stretching away towards the trochanters, and opening at a great distance from the bowel. These extensive fistulae and sinuses are frequently connected with structure of the gut; but they may occur without this in old and neglected cases.

Varieties.—Fistula in ano is said to be *Complete* when it communicates by one end with the interior of the rectum, and opens by the other upon the external surface. It is said to be *Incomplete* when it has only one aperture, whether that be external or internal.

Complete Fistula is the most common form. It probably arises in the majority of cases from some source of irritation seated within the bowel, by which the mucous membrane of the rectum has been perforated, and an abscess has formed in the cellular tissue outside the gut. The external opening in this form of fistula is usually from half an inch to an inch from the margin of the anus; though it may be seated at a greater distance than this, as upon the hip. It is commonly small, and has a vascular granulation projecting from or occluding it; and a thin purulent discharge usually drains away from it in small quantities, moistening the surrounding integuments. The internal opening is usually situated just above the sphincter, where the rectum begins to expand. But the fistula does not terminate at this internal aperture; for in the majority of cases it runs up into a kind of *cul-de-sac*, to a considerable distance further. The internal aperture may readily be detected by introducing a blunt curved probe into the fistula; when, by a little management, it may be carried through the inner opening. In some cases, the existence of this may be ascertained by examining the interior of the bowel with a speculum ani, and by injecting water into the external opening.

Incomplete or Blind Fistula may be of two kinds, and commonly arises from constitutional causes. When there is no internal perforation, a mere sinus having been left by the bursting of an abscess, the fistula is termed *blind external*. When there is only an internal aperture, it is called *blind internal*. The blind external fistula is readily recognised by its being found that the probe does not penetrate the interior of the gut. The blind internal is not so readily detected; but in this case it will generally be found that the patient suffers from an occasional and tolerably abundant discharge of pus from the interior of the bowel; that there is a good deal of tenderness, with some brawny induration in the ischio-rectal fossa on one side of the anus; and that the pus may be made to well out in some quantity by pressing upon this part. On passing the finger into the rectum, the ragged internal aperture in the gut through which the pus exudes may readily be felt.

Treatment.—Operative interference is usually necessary. It is true that in some rare instances the fistula may be made to close under the influence of constitutional management, aided, perhaps, by stimulating its interior with the nitrate of silver, or by touching it with a probe dipped in nitric acid. This kind of treatment is, however, only successful in the blind external fistula, several instances of which I have seen recover in this way; but it can never be expected to answer in any other variety of the disease. Occasionally in elderly people a blind internal fistula (or fistule) will be found, which, falling into a very chronic state and discharging but little, is a source of but very trivial discomfort, and will continue for years without giving the patient serious local inconvenience, and in no way disturbing the general health. In such cases, I believe, there is often far less risk in leaving the fistula untouched, than in subjecting the patient at an advanced period of life to the hazards of an operation. When the fistula is complete, the only plan of treatment that offers any chance of success is the division of the sphincter; so that this muscle, which tends to prevent the closure of the anus, may be paralysed, and the fistula, being laid open from the bottom, made to heal by granulation. Various plans have been devised for

the division of the sphincter, and much ingenuity has been expended in attempts to discover simpler and less painful modes of effecting this than the knife, but hitherto without success; and the only plan of treatment that deserves any attention is the division of the sphincter with a curved bistoury.

The operation for fistula in ano should not be performed indiscriminately in all cases and at all periods of the disease. If the fistula be dependent upon stricture of the gut, and more especially if this be of a malignant character, it is evident that no operation can be attended by a chance of success, and none should be attempted. So, also, if the patient be cachectic and broken in health, it is well to improve his constitutional powers before undertaking an operation, lest the wound that results may not readily cicatrise. It is also well to wait until the disease has assumed a somewhat chronic form before proceeding to the division of the sphincter; if this be done early after the bursting of the abscess, or at any time if there be much inflammatory action going on, the wound is apt to assume a somewhat sloughy condition, and to heal with great difficulty. The most important question usually connected with the operation for fistula, is the propriety of performing it in phthisical subjects. It is a well-known fact that fistula in ano is especially apt to occur in consumptive individuals, and it is often a nice point to determine whether an operation should be performed or not in them; how far the drain from the fistula may keep up or even generate the tendency to phthisis, or how far it may be salutary in acting as a counter-irritant, and in preventing the morbid condition of the lung from developing itself. Dr. Theophilus Thompson states that the co-existence of fistula with



Fig. 406 —
Fistula in ano.
See text for details.

phthisis appears to retard the progress of the latter disease, acting as a derivative; and doubtless in some instances this may be so. I have, however, in several cases found considerable advantage result from operating for fistula in the early stages of phthisis, or in suspected cases of that disease, the patient's health having considerably improved after the healing of the fistula. In such cases, it may be of use to put an issue in the arm or side of the chest. But in confirmed, and still less in advanced phthisis, no operation should ever be practised; as the wound will not heal, and the patient must be weakened by the additional discharge.

The operation for complete fistula should be performed in the following way. The bowels having been well cleared out the day before with a dose of castor-oil, and an enema administered on the morning of the operation, the patient should be laid on his left side, with the nates projecting over the edge of the bed; a probe must then be passed through the fistulous track into the rectum, and the surgeon, introducing the forefinger into the gut, feel



Fig. 407 — Operation for Fistula in ano

the end of the instrument; he then passes a short strong-bladed probe-pointed bistoury of about the size and shape of that represented in the annexed figure (406), through the fistula, using the probe as a guide, though in some cases this may conveniently be dispensed with. When he feels the end of the knife projecting into the rectum through the internal aperture of the fistula, he withdraws the probe, hooks his forefinger over it (Fig. 407), and by a sweeping and pressing cut, raising the handle of the instrument at the same time that he pushes down its point, brings both finger and blade to the anal aperture, cutting through the whole thickness of parts between the anus and the fistula, so as to lay the two cavities into one. In performing this operation the surgeon should cut with his left hand if the fistula be upon the left side; and in either case should be careful not to wound his own finger, as such cuts often prove troublesome in healing. If sinuses stretch from the fistula along the nates or hip, he may slit these up with a probe-pointed bistoury, before or after dividing the sphincter. If the fistula be a blind external fistula, it must at the time of the operation be made complete, by scratching with the end of the knife through the thinned structures that intervene between its extremity and the interior of the gut; and the operation must then be completed in the way described. If it be a blind internal fistula, a bent probe should be passed up the anus and through the inner opening of the fistula into the canal. The end of this, which can be felt externally, must be exposed by a puncture made through the integuments with a sharp-pointed bistoury, and the operation then concluded in the ordinary way.

When there is an internal aperture into the gut, this will usually be found just above the sphincter; but the fistula does not terminate here, frequently extending up by the side of the gut for an inch or two. Under these circumstances, what should be done with the *cul-de-sac* above the inner aperture? If it be laid open, an extensive and deep wound will be inflicted, which may implicate some of the hemorrhoidal vessels, and thus give rise to a dangerous amount of bleeding. Hence I think it a safer practice for the surgeon to content himself with the division of the sphincter and all the parts intervening between the inner aperture of the fistula and the verge of the anus; the sinus which is left usually contracting and closing without difficulty when this has been done. In some cases it happens, however, that this *cul-de-sac* is not readily obliterated, but gives rise to a good deal of trouble in consequence of the occasional accumulation of pus in it, and the thickening of its aperture into the bowel giving rise to spasmodic contraction of the sphincter and a kind of rectal stricture. This inconvenience gradually subsides in most cases, by the use of astringent injections or the introduction of a probe armed with nitrate of silver.

The after-treatment should be as simple as possible, consistently with securing closure of the wound by granulation from the bottom. A narrow slip of oiled lint should be introduced between the lips of the wound, and this must be left in for forty-eight hours, during which time the bowels are kept confined by the administration of a grain or two of opium immediately after the operation. On the second day a dose of castor-oil may be administered, which will not only act upon the bowels, but bring away the piece of lint. The wound must then be lightly dressed from the bottom, a poultice applied, and care taken at the daily dressing, by the introduction of a probe, to prevent the bridging over of granulations. After the wound has completely united, a notch will usually be left by the side of the anus, which gives rise to some inconvenience for a time by the occasional involuntary discharge of a little intestinal mucus, and some flatus. This especially happens in those

cases in which the incision has been made anteriorly to the anus into perineum, and where incontinence of feces may, for a time, be left. Should an inconvenient or dangerous amount of hemorrhage occur at the time of the operation, the wound should be plugged with dry lint, and a firm bandage applied by means of a T-bandage. Should profuse bleeding, in consequence of the division of some of the hemorrhoidal vessels, come on a few hours after the operation, all coagula should be cleared away, the gut washed with ice-cold water, and then securely plugged either with a piece of compressed sponge, or with a bougie, surrounded by lint soaked in a solution of perchloride of iron.

HEMORRHOIDS OR PILES.

By *Hemorrhoids* or *Piles*, is meant a morbid condition of the blood-vessels of the anus and lower part of the rectum, especially of the veins of the mucous and subcutaneous cellular tissue, giving rise to more or less intolerance of the part, which may or may not be attended with a discharge of blood. Surgeons are commonly in the habit of classifying piles, according as they bleed or not, into *Open* or *Blind*; or, according as they are situated above or below the verge of the anus, into *Internal* or *External*: the internal being always within the gut, the external habitually protruding out of around the anal aperture. The first may either bleed or not, the latter always blind. To this division into external and internal, B. Cooper added an intermediate variety, the *Intero-External*, which is partly within and partly without the anus. These divisions are of much practical importance as the treatment is very materially modified according as the hemorrhoids are situated above or below the anal verge.

PREDISPOSING CAUSES.—We must look to the peculiar arrangement of veins of the rectum as directly predisposing to the occurrence of piles. The lower part of the rectum and the verge of the anus are composed of a plexus of muscular fibre and a muco-cutaneous surface, with an intervening stratum of dense cellular tissue. In this cellular membrane is situated a dense interlacement or net-work of tortuous veins. The blood, from this plexus of hemorrhoidal veins, finds its way into the general system through distinct channels. By far the greatest portion of it is carried into the inferior mesenteric vein, and thence into the vena porta, through the medium of the superior hemorrhoidal vein, which may be looked upon as the extreme end of the portal system; and a certain quantity passes into the internal iliac vein through branches that accompany the middle hemorrhoidal artery. We may, therefore, look upon the hemorrhoidal plexus as being placed midway between the portal and general venous systems, being the point indeed at which they touch; but as belonging rather to the portal than to the general veins. In these arrangements we see all the elements that would predispose to congestion, and consequent dilatation of the vessels of a part. There is a large and intricate plexus of veins in which, as in all similar networks, there is a tendency for the blood to circulate slowly at times; the natural tendency to stasis of the blood being much increased by the dependent position of the part, and by the anatomical fact that, in consequence of the absence of valves in the superior hemorrhoidal vein and in the vessels into which it pours its contents, the whole pressure of the column of blood in the portal system may be brought to bear upon the hemorrhoidal plexus. The circulation through the portal system is likewise subject to much interference in consequence of hepatic and intestinal obstruction, and in these changes the blood in the hemorrhoidal plexus also participates; and were it not for the provision that exists by which this plexus may free itself to a certain extent

from over-distension by its communication with the internal iliac through the medium of the middle hemorrhoidal vein, piles would be much more frequent than they even now are, as a consequence of obstructed portal circulation. Another great cause of hemorrhoidal enlargement is to be found in the want of support that the veins of this plexus experience on their mucous aspect during defecation. Situated as they are in cellular tissue, between a plane of muscular fibres on one side, and yielding mucous membrane on the other, when distended by the constriction which they undergo during and after the expulsion of the contents of the rectum, they necessarily give way on that side on which they have the least support, being forced down and elongated, together with the mucous membrane under which they ramify, and which has a natural tendency to become slightly everted during the act of defecation. It will be found that all the more immediate or exciting causes of piles act by unduly increasing one or other of those natural tendencies that exist in the system, by favouring the local congestion or determination of blood, at the same time that they produce a lax state of fibre.

Age exercises considerable influence in predisposing to piles. This disease is not unfrequently met with in young men of eighteen or twenty years of age; more especially if they be of a relaxed and phlegmatic temperament with languid circulation, and be obliged to lead a more sedentary life than is natural or proper at that age. After this period, the liability to the disease diminishes until middle age is reached, when the tendency to hemorrhoidal affections is again increased, and becomes more marked than at any former period of life, owing to the more active operation of those causes that tend to impede the return of the portal blood.

Sex appears to exercise more influence on the occurrence of hemorrhoids at particular periods of life, than on the general liability to the disease. It certainly appears to be more frequently met with amongst men at an early age, than in young women; but at a later period of life, so far as my observation goes, the disease occurs with nearly equal frequency in both sexes. The comparative exemption of young women is readily accounted for by the periodic discharges from the uterus preventing the congestions that might otherwise occur in the parts in its vicinity. The greater frequency in females at a later period of life is attributable not only to the tendency induced during pregnancy by the pressure of the gravid uterus, but also, after the cessation of the menses, to the determination that is apt to be set up in certain organs of the female economy, and to the retardation of the portal circulation by the accumulation of fat and other causes; these conditions chiefly occur in women of a sanguine and plethoric habit of body.

A *sedentary life* with indolent habits constitutes, perhaps, the most powerful predisposing cause of the disease; more especially if habitual high living be conjoined with want of proper and sufficient exercise. Indeed, the artificial and luxurious habits of the more opulent classes, by diminishing tone at the same time that they occasion plethora and a tendency to abdominal engorgement, exercise a considerable influence on the occurrence of this disease, which is much more frequent amongst them than in persons in the humbler walks of life.

There are a number of minor conditions which are commonly looked upon as predisposing causes of this disease, though it is extremely difficult to determine the precise share that each has in its occurrence. Amongst these may be mentioned intemperance in food and drink; residence in warm, moist, and relaxing climates; the use of soft and warm beds; or the opposite condition of sitting on a cold stone or damp cushion. Over-excitement of the generative organs will also occasion it.

EXCITING CAUSES.—Amongst the exciting causes may be mentioned irritation of any kind. Thus, in some people hard riding will bring on attack of piles. The *habitual use of drastic purgatives*, more especially aloes, rhubarb, &c., is well known to occasion the disease, though it may be observed that individuals, who make habitual use of these remedies, or labour under some of those obstructions of the abdominal viscera that have already been noticed as conducing to piles. The existence of other diseases about the rectum and anus, such as fistula, ulcer or stricture, by inducing local congestion and irritation, may excite the disease; so also uterine and various diseases of the genito-urinary organs may give rise to the affection.

The most direct exciting cause of piles is certainly a *retardation to the return of the portal blood*. Any impediment to the onward current of blood through the hemorrhoidal or mesenteric veins, the trunk or ramifications of the vena porta, exercises a marked influence on the tendency to congestion of the hemorrhoidal plexus. Habitual constipation; the accumulation of hardened feculent masses in the large intestine; the want of secretion from the mucous surface; obstruction to the proper action of the liver, and consequent congestion of that organ; the pressure of abdominal tumours, or of the gravid uterus, are all active exciting causes, interfere as they do with the proper return of the portal blood. In some cases, the existence of an obstacle to the circulation in the systemic veins may occasion this disease; thus it will arise from the pressure of an aneurismal tumour on some of the larger venous trunks within the chest.

STRUCTURE.—A pile, whether external or internal, consists essentially in the first instance of a varicose condition of a portion of the hemorrhoidal plexus, or rather, of the small veins of the submucous tissue that pour their contents into this; this varicose condition, becoming prominently developed at certain points, gives rise to small knots or tumours. A pile in this state is quite soft and compressible, and can readily be emptied by pressure. When cut into, it will be found to be composed of one or more cells filled with blood, and surrounded by areolar tissue. The appearance of cells is, however, deceptive, and is occasioned by a section of the anastomosed and dilated veins that enter into the composition of the tumour. After the piles have existed for some little time, or after they have once become inflamed, the tissues that enter into their composition undergo modifications that induce corresponding alterations in the character of the tumour. The coats of the veins become thickened; their cellular dilatations are filled with coagulated blood; the investing areolar tissue is hypertrophied or thickened by plasma deposit; and, on being cut into, the pile is seen to be composed of a spongy kind of tissue filled with blood. External piles, when examined after removal, often resemble in structure a mass of hypertrophied cellular tissue infiltrated with plastic matter, in which a number of small vessels of unimportant character ramify, but without any appearance of cells. Internal piles, on the contrary, contain more of the venous, and less of the cellular element. They are also commonly furnished with a small central artery, which is liable to bleed freely, or even dangerously, if the tumour be cut across; hence, provided they are not clogged with coagulated blood, they may readily be removed from the inferior mesenteric artery.

In studying the structure of hemorrhoids, it is of importance to observe that they occur under two different forms: one in which there are distinct tumours, within or external to the anus, and another in which there is merely a varicose condition of the veins of this region, without distinct intumescence.

In those cases in which there is merely a general varicose state of the veins of the submucous cellular tissue of the anus, without any distinct tumour springing above the level of the membrane, it will be found that the smaller branches of the hemorrhoidal plexus, and the small twigs that enter these from the submucous cellular tissue, have undergone varicose dilatation, being apparently greatly increased in number, as well as in size. The mucous membrane is of a deep mulberry or port-wine colour, and becomes everted after each motion. There is usually some mucous secretion about the anus, rendering the part moist : and the patient complains at times of weight and of bearing down, with pains either in the part itself, in the sacro-lumbar region, or in the thighs. The motions, more especially if hard, are streaked with blood, and more or less of this fluid drops in a rapid manner after the passage of the feces. There is seldom much blood lost ; but at times there is an exacerbation of all these symptoms, and the hemorrhage, as will more particularly be mentioned hereafter, may become very abundant. This condition of the mucous membrane may precede, and is frequently found to accompany the true pile, whether external or internal, and may be looked upon as constituting the first stage of this disease. If this state of things be allowed to continue unrelieved, the tendency to congestion increases ; more and more of the mucous membrane becomes everted and protruded after defecation ; the submucous cellular tissue becomes stretched and lax, and the case is apt to become one of prolapsus ani.

EXTERNAL HEMORRHOIDS are those that are situated below the verge of the anus, and that are invested by cutaneous, or, at most, by muco-cutaneous tissue. Before appearing as defined tumours, they usually constitute longitudinal folds that surround the anal aperture, or radiate from it as from a centre. In colour, they vary from that of the natural structures to a pink or purplish hue ; and their tegumentary covering consisting of the thin skin of the part, they resemble folds of this tissue rather than of mucous membrane. Their size varies, according to the state of congestion ; and hence the same tumour may at one time be soft, flaccid, and loose, apparently nothing more than a fold of integument, and at another may become tense, tumid, and ready to burst.

Symptoms.—When of small size and recent formation, external piles do not in general give rise to much distress, merely some local heat, pricking, and itching, with a sense of fulness after defecation ; but when of large size, and inflamed or irritated, they may occasion very acute suffering. There is not only deeply seated, dull, aching and throbbing pain in the pile itself, but this shoots up the side of the rectum, through the perineum, and into the nates, and is much increased when the patient stands or walks. After a few days these symptoms subside ; suppuration either taking place in the pile, or the blood contained in it coagulating. The parts are, however, left in a thickened and indurated state, and do not really resume their former soft and flaccid condition, effusion of plastic matter taking place into the cellular tissue, and the contained blood perhaps coagulating, so that the tumour can no longer be emptied by pressure, assuming the form of a broad, rounded, or indurated mass.

INTERNAL PILES.—When the pile is situated altogether within the verge of the anus it is called internal ; of these there are two principal varieties, the *Longitudinal* and the *Globular*.

The *Longitudinal*, or, as it is sometimes called, the *Fleshy* pile, is generally met with about an inch or two up the rectum. It is spongy, elastic, firm, or tough, of a dark reddish, or dusky brown tint, tapering upwards from a broad base. It seldom bleeds or varies much in size ; between the piles are

found small curtains, valves, or folds of mucous membrane, forming sacs or pouches, with their convexities looking upwards. These sacs are liable to become distended and pressed downwards by the force, especially if the motions be hard and the bowels have been constipated, thus giving rise to a tendency to prolapsus.

When the hemorrhoid assumes a *Globular* form, it constitutes the *internal bleeding pile*. It may be situated on a broad base; or, as not unfrequently happens, its point of attachment to the mucous membrane becoming elongated, it assumes a pedunculated shape, hanging downwards into the end of the rectum. It is of a dark bluish colour, and numerous small vessels of a brighter hue than the body of the pile may be seen ramifying on the mucous membrane investing it. Its surface is at first smooth and shining, and may continue so throughout, being covered with a thin coat of mucus, or prolongation of the lining membrane of the gut. Not unfrequently, however, superficial ulceration takes place, and then it has a granulated or berry-like appearance.

Symptoms—Internal piles are usually attended by a sensation of itching, pricking or smarting about the anus, and a feeling as if there were a foreign body within the gut. After defecation these sensations are increased, and are often accompanied by a bearing-down, as if the bowel were emptied of its contents, that is peculiarly distressing and sickening. It is occasioned by the piles, or the elongated and condensed mucous membrane to which they are attached, being protruded during the expulsion of the feces, and not returning sufficiently quickly, being grasped by the sphincter ani and constricted by it. This feeling of discomfort and bearing-down is much increased, if the patient stand or walk much after having had a stool, or if he have a confined state of the bowels. If this state of things is not properly attended to, the symptoms become increased in severity, the bearing-down sensation amounts to true tenesmus, and the act of defecation becomes so painful that the patient defers it as long as possible, and when it does take place, in consequence of the accumulated stores, and their indurated character, the suffering is much increased. Internally, now usually make their appearance, if they have not existed before. The mucous membrane of the rectum becomes prolapsed, and an increased secretion of thin mucus takes place from the orifice of the gut, soiling the part and soiling the patient's linen. Irritation in the neighbouring organs is frequently set up; occasionally to so great an extent as to become the original complaint, the patient referring his principal pain and distress to these sympathetic disturbances. There is often a dull aching fixed at the lower part of the lumbar spine, and more frequently over the sacrum or the sacro-iliac articulations on either side; this is sometimes severe, perhaps down the thigh, or round the groins; irritability of the testicles may come on, or irritation about the neck of the bladder, or frequent desire to micturate, and increasing the patient's suffering by straining that takes place. The general health now suffers, the patient becomes emaciated, and the countenance often presents a peculiarly anxious and drawn, and care-worn look.

The symptom, however, that first of all and most prominently fixes the patient's attention, is *Hemorrhage*. This varies greatly in quantity, and it may merely consist of a few drops falling after the passage of a motion, or the cylinder of feces may be stained on one side by a streak of blood, or it may amount to several ounces or even pints. When moderate in quantity, it often affords relief to the other local symptoms, and seldom proves injurious from the quantity lost at one time; but, if

fuse, and occurring at short intervals, its effects on the constitution may be alarming.

The hemorrhoidal flux is connected with, and in the great majority of cases dependent upon, the existence of distinct hemorrhoidal tumours. Occasionally, however, it appears to occur when there is no distinct separate tumour projecting above the surface of the membrane; but in these cases there is general intumescence and congestion of the whole of the mucous membrane of the lower part of the rectum, from which the blood exudes in drops, or it may even spurt in a distinct jet from the open mouth of a blood-vessel.

It is frequently ushered in by an exacerbation of those symptoms that commonly accompany piles, such as a sensation of fulness, weight, and tension, about the parts. But the symptoms that precede its occurrence are often much more imperfectly marked than is usually stated, and are frequently absent altogether.

The discharge of blood may be periodical, occurring every month, or at intervals of two, three, or six months; and it may be remittent or intermittent. When once it has set in, it usually continues from three to six days, increasing in quantity up to the third or fourth day, and then lessening.

When moderate in quantity and short in duration, it is often a source of relief to the patient; but if a very large quantity be lost at one time, or if it continue for too long a period, more harm is usually done to the patient by its long continuance than by its excessive quantity at any one time. The patient may become much debilitated; nervous headaches, pallor, palpitations, and syncope may result. In some cases, it has been said that this discharge is of service, acting as a derivative, and preventing disease from falling on more important parts; it has especially been looked upon as, and doubtless is in many cases, a safeguard from apoplexy and visceral congestions and obstructions, particularly when it occurs in plethoric and corpulent persons who habitually live too high. In other cases it may be considered as critical; especially when it occurs about the cessation of the menstrual period.

The colour of the blood is most generally florid, as if it came from the small arteries or capillaries of the part rather than from the veins. It would appear that, in consequence of the over-distended and varicose condition of the veins of the part, the onward flow through the arteries and capillaries leading to them was obstructed; and that in consequence of the accumulated pressure on these vessels their parietes gave way, allowing the florid blood to escape from the veins.

Very commonly the internal piles, when brought down, present a somewhat granular surface, in consequence of ulceration having taken place, and the whole surface will be seen to exude blood in drops. In other instances, the blood appears to come from a cavity in one side of the hemorrhoid, as if rupture had occurred from over-distension at that part. Occasionally, however, the flow of blood is so rapid and copious that it cannot be supposed to come from exudation, but would appear to depend on rupture of the vessels of the part.

The hemorrhoidal flux may be accompanied by, or alternate with, a thin glairy mucous discharge from the rectum and diseased structures, this would appear to be nothing more than excessive secretion from the membrane, in consequence of the irritation set up by the pressure of the piles; it is seldom in sufficient quantity to produce much annoyance, or to be of much moment to the patient.

COMPLICATIONS.—Piles are not uncommonly complicated with other diseases of the rectum, such as fissures, fistula, or prolapsus. When connected with fissure, the hemorrhoid often, as Syme has remarked, assumes a peculiar form and appearance, presenting itself as a small red colourless body, like a pea in size, firm, and seated at the base of the fissure, which often conceals; to a practised eye, however, the presence of a pile of the peculiar colour and shape is sufficient to indicate the existence of the fissure.

In that form of fistula in which the aperture is near the anus, one or more external piles of small size are often found situated at the orifice of the fistula; and prolapsus rarely, if ever, is met with in adults, without the simultaneous occurrence of piles.

TERMINATIONS.—Hemorrhoidal tumours may terminate by Subsidence, Coagulation, Suppuration, or Sphacelus.

Subsidence.—Complete subsidence of the pile can only take place when the disease is of recent occurrence. When of long standing, and after has been exposed to successive attacks of inflammation and turgescence, never subsides completely; and the cellular tissue and the muco-cutaneous structures, becoming hypertrophied, form elongated pendulous flaps about the margin of the anus.

Coagulation of the contents of the pile is the result of inflammation having taken place in it, and probably terminating in plastic effusion, by which the vessels leading from it are obstructed. When it takes place, the tumour after more or less active inflammation, becomes hard, incompressible, and indolent, permanent in size, and of a purplish or plum-colour. The coagulum thus formed may remain persistent, may excite suppuration, or may be absorbed, the hypertrophied tissues forming one of the usual anal folds. In some rare instances, the coagula may become converted into structures resembling phlebolites.

Coagulation more frequently takes place in external than in internal piles, owing to the great impediment to the return of the blood from them, and to their greater liability to inflammation, their exposed situation leading them to be bruised or otherwise injured. When it occurs in internal piles, it more commonly affects those that are of a columnar or longitudinal shape, and least frequently the globular variety.

Suppuration is not an uncommon termination, if acute inflammation has been set up in external piles, more especially in those that have previously been coagulated. When the abscess is discharged, small coagula escape with its contents, the cavity granulates and becomes obliterated, and the pile cured.

Sphacelus.—In some cases, when there is much elongation of the mucous membrane from which the pile springs, prolapsus of that membrane and of the piles may take place; and thus being grasped after it has descended by the contraction of the sphincter, the same effect may be produced as if a ligature were applied. The tumour becomes much swollen, hard, livid, and tense, there are much constitutional disturbance and restlessness, but after a few days all the symptoms are relieved by the part that is constricted sloughing and dropping off.

DIAGNOSIS.—The diagnosis must be regarded in two points of view; 1, as concerns the *Hemorrhoidal Tumours*; and 2, with reference to the *Hemorrhoidal Flux*.

1. *Hemorrhoidal Tumours* must be diagnosed from prolapsus ani, polypus of the rectum, and condylomata about the anus. From prolapsus the diagnosis is not always easy; indeed, the two diseases are so generally associated, that it is of little moment to attempt it. In true prolapsus, con-

examination will suffice to distinguish the membranous wall of the intestine, forming a smooth, rounded, and somewhat lobulated annular protuberance, from the isolated tumours of piles. In *polypus*, the history of the case, the pedunculated and solitary character of the tumour, its large size, and comparatively slight tendency to periodical hemorrhage, will enable the surgeon to make the diagnosis. From *condylomata* the diagnosis is easy; the soft, flat, mucous, and wart-like character of these growths, their history, and their occurrence at other points, as the perineum, scrotum, vulva, and buttocks, will enable the surgeon to distinguish them without any difficulty.

2. The *Hemorrhoidal Flux* must be distinguished from other *intestinal hemorrhages*. This may be done by attention to the character of the blood, which will enable us in many cases to determine its source. When it comes from piles it is liquid, of a more or less florid colour; and not unfrequently is quite bright, staining or coating the feces rather than being mixed up with them. When, on the contrary, the blood is poured out at some higher point in the intestinal canal than the usual seat of hemorrhoids, it is of a dark sooty character, mixed up with liquid feces either in a diffused form, or in small black coagula, and no fresh or bright blood will be visible. Digital exploration of the rectum in cases of piles, and the presence of symptoms indicating the existence of mischief at a higher part of the intestine than the anus in cases of melæna, will also serve to point to the seat of the flux.

TREATMENT.—In conducting the treatment of a case of piles, that surgeon will succeed best who looks upon the disease not as a local affection, merely requiring manual interference, but as a symptom, or rather an effect, of remote visceral obstruction and disease, the removal of which may alone be sufficient to accomplish the cure, without the necessity of any local interference; or, should it be thought necessary to have recourse to operative procedure, this must be made secondary to the removal of those conditions that have primarily occasioned the congestion and dilatation of the hemorrhoidal vessels. The treatment of piles, therefore, must be considered, 1, as regards the removal of those Constitutional Conditions or Visceral Obstructions that occasion the disease, together with any Topical Applications that may be considered necessary; and, 2, with reference to the Operative Procedures that may be required for the removal of the affection.

1. The *Constitutional Management* of piles necessarily varies considerably, according to the condition of the patient in which they occur, and the visceral obstruction to which they may be referrible. Thus, when they occur in debilitated persons, apparently from relaxation of the vessels, most benefit will be derived from a mild tonic and nutritious plan, at the same time that the bowels are kept regular by some of the aperients that will immediately be mentioned. In these cases, also, much advantage is often obtained by the administration of the confection of black pepper, which acts as an useful local stimulant to the vessels of the rectum. In the great majority of instances, however, more particularly when occurring about the middle period of life, piles are connected with a plethoric state of system, and obstruction of the abdominal viscera. Under these circumstances, our efforts should be directed to the reduction of the plethoric condition, by putting the patient upon a proper regimen, prohibiting the use of stimulants, and lessening the quantity of animal food that he is in the habit of taking. When piles arise from the pressure of a gravid uterus or other abdominal tumour, little can be done; except, by local palliatives and mild aperients, to moderate the inconvenience attending them.

In all cases of piles, but more particularly in those arising from hepatic obstruction, mild aperients are of essential service; by removing fecal accumulations, and establishing a free secretion from the intestinal surface they tend materially to prevent congestion of the portal system. At the same time, drastic purgatives of all kinds should carefully be avoided. The most useful aperients are the electuary of senna, sulphur, and castor-oil; or other of which should be taken regularly twice or thrice a-week at a time, in as small a quantity as will be sufficient to keep the bowels free. In many cases the confection of senna may advantageously be given in conjunction with precipitated sulphur and the bitartrate of potash, equal parts each of these being made into a mass with twice their quantity of the confection and a little syrup; of this electuary a dessert-spoonful may be taken every night or every second night. If there be a relaxed condition of the rectum and anus conjoined with the piles, as not unfrequently happens, not only in old as well as in young people, the administration of an electuary composed of equal parts of the confectios of senna and of black pepper, or of castor-oil will be found very useful. In fact, in all cases in which the black pepper is administered, an aperient should be given from time to time, to prevent accumulation in the large intestine. When the liver is much obstructed the treatment should be specially directed to the relief of this organ. In this view, a course of Plummer's pill, followed by taraxacum, and, in relaxed constitutions, the mineral acids, will be found especially serviceable, at the same time that the bowels are kept free by gentle aperients.

The habitual use of lavements, consisting either of soap and water or gruel, will be found advantageous in many cases of piles, though in some they appear to irritate, and rather to increase the disease. When they occur in relaxed constitutions, the lavement should be used cold; but in the patient is of full habit of body, a tepid one will usually be found to agree best. In the general management of piles it need scarcely be observed that any habits which favour the disease should be sedulously avoided.

The *Local Treatment* of piles is of considerable importance. The piles should be regularly sponged with cold water, morning and evening. If there be much relaxation, and the piles be internal, benefit may result from the employment of some astringent injection, such as a very weak solution of the sulphate of iron, or of the tincture of the sesquichloride—a grain of the first, or ten drops of the second, to an ounce of water; of this solution two ounces may be injected every night, and left in the rectum. The application of an astringent ointment, such as the unguentum galle compound, or the employment of the anodyne and astringent suppository already recommended, will be attended with much benefit.

If the piles become inflamed, the patient should keep his bed, and ice should be freely applied around, but not upon the tumours. Tepid lotions, poultices, and poppy fomentations, must be assiduously used, a very strict diet enjoined, and the bowels opened by mild saline aperients. If a cancerous form in an external pile, as the result of inflammation, the tumour should be laid open with a lancet, and its contents either squeezed, or turned out by the flat end of a director. If abscess form, it must be punctured in the usual way, and the part afterwards poulticed. Should strangulation of piles take place, the protruded swelling must be returned by gentle external pressure, and the part afterwards well poulticed.

2. *Operation.*—The means above indicated are usually sufficient in ordinary cases of piles; but, if the disease attain an inconvenient size, give rise to general irritation and local uneasiness, or if the abundance of hemorrhage be such as seriously to interfere with the health of the patient,

it will become necessary at last to have recourse to operative interference, with a view of removing the diseased structures. No operation should ever be undertaken whilst the pile is in an inflamed state, lest unhealthy inflammatory action to an undue extent be set up in the part; it is also well to get the patient's health into a good state, as erysipelas may otherwise follow the operation; and before proceeding to perform it, care should always be taken that the bowels have been well opened.

There are three plans of treatment adopted by surgeons for the removal of piles; viz., the excision of the tumour, its strangulation by ligature, or destruction by caustics. These methods of treatment should not be employed indiscriminately. The first is alone applicable to external piles; the last two may be adopted in the internal form of the disease.

Excision.—The removal of external piles is readily effected. The tumour should be seized with a vulsellum or hook, drawn forwards and snipped off with a pair of knife-edged scissors, curved upon the flat. At the same time when the external piles are removed in this way any pendulous flaps of skin in their vicinity should be excised, lest they become irritated, and constitute the basis of a fresh pile. After the excision of external piles, there is usually but trifling hemorrhage, which may readily be arrested by the application of cold hut, or a pad and T-bandage; should any small artery bleed, it may be pinched, and the hemorrhage thus stopped.

Ligature.—Internal piles should be removed by the ligature only; in fact, it may be laid down as a rule in surgery, that all external piles should be cut off, and all internal piles tied. The reason of this difference in the practice to be adopted, according as the pile is situated above or below the margin of the anus, is the liability to hemorrhage in the one case, but not in the other. The bleeding that follows the excision of an external pile is not only small in quantity, but may readily be arrested by cold or pressure. With internal piles, however, it is different; these tumours are not only more vascular, being often fed by a large central arterial twig, but are deeply seated, and do not readily admit of the application of means for the arrest of the flow of blood from them. So difficult is it to stop the bleeding from an internal pile in some cases, that patients have actually lost their lives from this cause after its excision, even in the hands of some of the most distinguished surgeons. The excision of internal piles has consequently been very properly abandoned.

The operation for the ligature of internal piles may most conveniently be conducted in the following manner. The patient, having had his bowels cleared out by a dose of castor-oil on the day preceding that fixed for the operation, should have an abundant lavement of warm water administered about an hour before the surgeon arrives; and he should then be directed to sit for half an hour on a bidet, or over a pan containing hot water, bearing down at the same time, so as to cause the piles to protrude. When all is ready, he should be laid on the bed on his left side, with the nates well projecting; the surgeon then seizes the most prominent pile with a hook, vulsellum, or broad-ended forceps (Fig. 408), draws it well forwards, and ties its base as tightly as possible with a thin whipcord ligature. He does the same to one pile after the other, until all that can be met with have been strangulated in this way. In some cases the pile is so broad at the base, that the ligature will not include it without transfixion; when this is required, it may usually be done readily enough



Fig. 408.—Broad-ended Forceps.

by means of a *novus-needle*, or by the following drawing (Fig. 409), Bushe's needle,



Fig. 409. — Bushe's Needle for Applying Ligature to Piles.

fixed in an ivory handle perforated for the recumbent point. The advantage only is the angle for a very convenient one a pile inside the anus the needle can be directed across the base so withdrawn more easily. If the pile be long it is in a direction upwards the ligature tied in whatever way the ligature taken that they are the piles may be effected this way they separate less pain to the patient all the tumours require

ends of the threads in a strangulated mass pile there be any external piles, these must not be done, they become irritated, swollen, and inflamed, and constitute a source of much distress to the patient, and should keep the recumbent position which usually happens from the sixth to the eighth day the surface will be left, which, however, speedily heals. In some cases this process may be facilitated by the insertion of a silver thread through a speculum ani. On the opening of the bowels may be opened with a dose of castor oil. In the case of the case, care must be taken to prevent the patient from giving rise to the affection in the first instance, more particularly if they be seated towards the rectum there is frequently great irritation set up, and the patient experiences difficulty in defecation, and suffers from complete retention; a warm bath, and *cymus* and nitric ether, will usually relieve. In some cases, when the external piles are large, and the patient debilitated, the ordinary rule of cure must be deviated from, and a combination of ligature be adopted. In such cases an incision is made into the integuments merely, and then the piles tied with a thread. By these means the pain and inflammation are removed, and on the inclusion of a portion of the integument at the same time that the risk of hemorrhage is avoided.

The treatment of piles by ligature is not applicable to persons of broken constitution. I have not seen any pyæmia result in these cases.

Chemical. — In certain kinds of internal piles, it has been recommended by Houston of Dublin, to be advantageously adopted. It must not, however, be used in the intero-external pile, as it will not be looked upon as a substitute for the

is especially in the granular pile, having an ulcerated surface, that this mode of treatment is useful: as in these cases it appears, by destroying a portion of the mucous membrane, not only to cure the pile to which it is applied, but, by producing an ulcer, to give rise to a cicatrix, which, by contracting, consolidates the parts in its vicinity, and so lessens the relaxed state of the rectum, which favours the hemorrhoidal tendency. The acid may most conveniently be applied through a speculum ani, having an aperture on one side (Fig. 110). This should be introduced, well oiled, until the pile project through the opening in it, when it must be freely rubbed with a piece of stick, or a glass rod or brush, dipped in the acid; the surface is then immediately wiped with a piece of lint saturated with prepared chalk and water, and the instrument removed. A thin slough separates, leaving a raw surface, which gradually cicatrises and contracts. The application of the acid occasions but little pain when made fairly within the rectum; but, if a drop of it accidentally come into contact with the muco-cutaneous surface, a vast deal of irritation and inflammation are excited. This plan of treatment, though useful in particular forms of pile, as when the tumour is granular or flat, so as not to admit of ready removal by the ligature, should not, I think, be practised when the ligature can be employed, as it is by no means so certain a mode of treatment. It cannot be considered altogether devoid of risk; for I have known one instance in which fatal erysipelas followed the cauterisation of piles with nitric acid.



Fig. 110. Speculum Ani.

PRURITUS ANI is often an extremely troublesome affection, the itching and general irritation about the anus being almost unbearable. In many instances it appears to be a true prurigo of this part; in other cases it appears to be connected with the irritation of external piles, worms, or some similar affection. The *Treatment* must in a great measure have reference to the cause. If there be an external pile, the removal of it, or if worms, their expulsion, will probably cure the disease. If it arise from prurigo, it will require some special treatment. In some cases the arsenical preparations will be found useful, together with the local application of chlorinated lotions, or those containing hydrocyanic acid.

PROLAPSUS ANI.

Prolapsus Ani consists in a protrusion of the mucous membrane of the rectum through the anal orifice; the cellular tissue that lies underneath it being also in the majority of instances much thickened and elongated. In the ordinary prolapsus, the muscular structures of the gut are not protruded; yet it has occasionally happened that the muscular coat has descended with the mucous membrane, an invagination of the bowel taking place, which constitutes a different and far more serious condition than the ordinary prolapsus.

CAUSES.—Prolapsus not unfrequently occurs in children, especially those who are feeble, or who suffer from much irritation of the digestive or urinary organs. In weakly persons generally there is a natural tendency to prolapsus; the slight protrusion of the mucous membrane which takes place during defecation being increased by any constitutional condition that gives rise to atony of the muscular system, especially if irritation of the intestinal mucous membrane be conjoined with this, as in dysentery, chronic diarrhoea, &c. So again, the habitual constipation often occurring in persons

of a relaxed habit of body, apparently proceeding from want of power in the rectum to expel its contents, and requiring constant straining at stool, predisposes to this affection. It is especially common in those who labour under stricture, stone, or any other disease about the urinary organs that requires a considerable effort to be made in expelling the contents of the bladder. In persons whose constitution has been relaxed by a long residence in India, this disease also frequently occurs. In other cases, and indeed usually, the prolapsus is associated with piles, the weight and dragging of the hemorrhoid drawing down the mucous membrane with it. This is especially apt to happen, when there is general hemorrhoidal tendency about the anus. In fact, the causes of prolapsus may be summed up under the heads: 1. Simple relaxation of tissue, such as is met with in children and weakly persons; 2. Sympathetic irritation, as in chronic tenesmus, stone in the bladder, &c.; 3. A hemorrhoidal condition of the vessels of the part.

DIAGNOSIS.—Prolapsus is readily recognised. It consists in the protrusion of a ring of mucous membrane of a red or purplish colour, and having a somewhat lobulated look, rather lobulated in shape, and varying in size from half a walnut to a small orange (Fig. 411). The mucous membrane covering the ring will be found to be continuous with that inside the sphincter, and thus constitutes the mark of distinction between the ordinary prolapsus and the invagination.



Fig. 411.—Prolapsus Ani.

has occasionally been met with of the whole thickness of the gut, for this affection, which is extremely rare, there is a deep and distinct cleft between the protrusion and the margin of the sphincter. In prolapsus there is, when the protrusion is down, a dragging and smarting sensation, often attended with a good deal of spasm about the neck of the bladder, and not unfrequently with symptoms of stricture. In chronic cases, the anal aperture will appear to be permanently relaxed; and on introducing the finger into it, it will be found to be widened and weakened. The folds of skin in its neighbourhood will be seen to be relaxed and elongated, radiating from it as from a centre: they are commonly bluish soft, somewhat swollen, and pendulous, and often the seat of a good deal of irritation. The protrusion at first occurs only after defecation, and then readily goes back of itself, or is reduced by the exercise of steady pressure upon it; after a time, however, it will come down at other periods, and may protrude after riding, walking, or even standing, and is returned with much difficulty.

Strangulation of the prolapsus may occasionally occur, if it be allowed to protrude for a considerable length of time without a proper attempt being made to push it back. It then becomes swollen and livid, with great pain and tenesmus, discharges a fetid ill-conditioned pus, and may eventually sink into a sloughy state, and, thus separating, undergo a spontaneous cure.

TREATMENT.—The treatment of prolapsus may be said to be palliative and curative. The Palliative Treatment consists in the first place reducing the tumour when protruded. Thus, under ordinary circumstances the patient does for himself; but, if it becomes congested, it requires

help of the surgeon to put it back. This may occasionally be readily done by laying the patient on his side, or making him lean over the back of a chair; and then greasing the mass with some oil, seizing it with a soft towel, and, gradually compressing it, working it back. It may be kept up by the patient wearing a belt with a pad and elastic support. Olive-shaped powder pessaries are occasionally employed, with the view of preventing the protrusion; but I have never seen them of any service, the sphincter being usually too relaxed to keep them up, and their pressure appearing to excite irritation.

The regulation of the bowels is as important in cases of prolapsus as in piles. It is usually best done by the administration of those laxatives that have been recommended for the latter disease. It is a good plan in prolapsus to get the patient to have his daily motion at bed-time instead of at the usual hour in the morning; the recumbent position and the uniform temperature of the bed preventing the irritation of the sphincter and spasm of the anal muscles that commonly continues for some time after the reduction of the prolapsus, and which is a source of great discomfort when occurring in the early part of the day.

Curative Treatment.—The relaxation of the mucous membrane of the rectum that essentially constitutes prolapsus may often be obviated by astringent injections or suppositories. The best injections are those of the sulphate of iron, in the strength of from one to three grains in an ounce of water, thrown up in small quantities sufficient for the bowel to retain. In children, injections of this kind, conjoined with regulation of the bowels by mild aperients, the administration of a moderate quantity of unstimulating food, and afterwards the employment of tonics, will commonly remove the disease, unless it arise from stone in the bladder, or some other affection inducing much and continued straining. In mild cases of prolapsus in adults, conjoined with a relaxed state of the mucous membrane of the rectum and relaxation of the sphincter, the use of the iron injections will be found particularly beneficial, at the same time that the action of the bowels is regulated by means of an electuary taken in the morning or at night. By thus giving tone to the bowel, at the same time that constipation is prevented, the disease will occasionally undergo a cure, provided it be not associated with any affection in other organs.

In those cases in which the prolapsus is hemorrhoidal, the protrusion being dragged down by the weight and strain of the pile, the same treatment must be adopted as has been recommended for the latter disease; and usually, after the ligature and removal of the pile, the prolapsus will be cured. In slight cases of prolapsus, in which the disease appears rather to be owing to the relaxation of the sphincter and of the tissues external to it, the mucocutaneous integument hanging in loose and pendulous folds around the anus, considerable benefit will commonly result from snipping off these pendulous flaps of skin; the cut surface that is left cicatrising, and by its contraction tracing up the part, and thus preventing its further protrusion. These pendulous flaps are best removed in a radiating manner from the anal orifice, with curved knife-edged scissors.

When the prolapsus is considerable, and if the ordinary palliative treatment have, after a proper trial being given it, failed in effecting a cure, it will be necessary to remove the protruded mucous membrane by operation. This should always be done by the application of the ligature; excision, though easy, being objectionable in this as in the case of piles, on account of the danger from hemorrhage.

Application of Ligature.—The patient having had the bowels freely opened

on the preceding day, and an enema of tepid water on the morning of operation, should be directed to sit over a pan of hot water, in order to make the prolapsus descend; it may then be seized with a pair of broad-ended forceps such as are represented in Fig. 408, and drawn well forwards. The base must next be firmly tied with a strong piece of whipcord, and a similar process repeated on the opposite side of the anus. Should there be any difficulty on account of the shape of the protrusion in ligaturing the base firmly, this may be obviated by transfixing it with a hemorrhoidal needle and tying it on each side. I think, however, that it is better, if possible, to avoid doing this. The ends of the ligature must then be cut short, the whole protrusion returned into the bowel, the external flaps of skin cut off, and an opiate pill administered, so as to arrest all peristaltic action for a few days. Should the ulcerated surface show any difficulty in healing, it must be touched with the nitrate of silver. This operation always leaves a permanent cure.

The ligature of prolapsus, like that of *internal piles*, is not very painful, and for it chloroform need not be administered; indeed, it is, perhaps, better that it should not be given in these cases, as the protrusion is apt to slip under its influence, the patient not being able to exercise the proper expulsive efforts. But, as the excision of the external flaps and piles is attended by very sharp suffering, it is as well to administer the anæsthetic at the time when they are being removed.

Should a prolapsus become strangulated, it would be necessary to try to reduce it through the sphincter by the employment of the taxis; if it cannot readily be accomplished, free incisions may be made into it; if it be not reduced, it will slough away, and thus undergo permanent cure. In some rare cases, a portion of invaginated intestine descending through the anus has become strangulated; in such cases as these, reduction must be effected; if possible without, but if necessary with, division of the sphincter.

DISEASES OF THE GENITO-URINARY ORGANS

CHAPTER LXVI.

URINARY CALCULUS.

CALCULOUS DIATHESSES AND DEPOSITS.

The urine is liable to the deposit of various solid matters, which, when amorphous and impalpable, are termed *Sediments*; when crystalline, they constitute *Gravel*; and when concrete, *Calculus* or *Stone*. These deposits, whatever form they assume, are the result of constitutional causes, and these constitutional conditions giving rise to them are commonly called *Diatheses*. Of these surgeons usually recognise three: the *Lithic*, the *Uric*, and the *Phosphatic*; besides these, however, others doubtless exist, the precise characters of which have yet to be determined.

LITHIC ACID DIATHESIS.—This diathesis chiefly occurs in individuals of robust habit of body and florid appearance, who have lived high and suffered from irritable gastric dyspepsia. It is often associated with a granular

neumatic tendency, or with some of the more chronic forms of skin disease, especially psoriasis. It is characterised by scanty and acid high coloured urine, which deposits on cooling two kinds of sediment, a yellow and a red. According to Lehmann, these sediments consist of urate of soda; but holding Bird, and, I believe, most of the chemists in this country, regard them as lithate or urate of ammonium. The yellow sediment, containing an admixture of the colouring matter of the urine, is usually dependent on slight disorder of the digestive organs and skin, coming and going under the influence of very trivial causes. The red sediment, owing its colour, according to Bird, to an admixture of purpurine, a highly carbonaceous ingredient, and indicative of imperfect assimilation, is met with in persons of full habit, who live too freely. A variety, or rather an admixture, of these sediments, constitutes the *lateritious deposit*, so common in gout and rheumatism. The red sand or gravel is a crystallised variety of the lithic acid sediment. It may be compared, in general appearance, to cayenne pepper, and under the microscope presents the characters seen in Fig. 413. It is not unfre-



Fig. 412.—Lithic Acid.

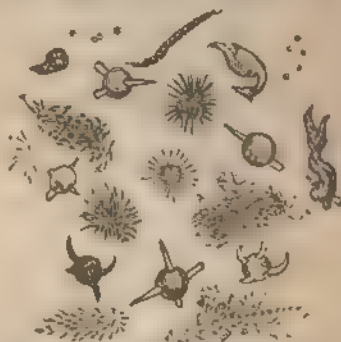


Fig. 413.—Lithate of Ammonia.

quently met with in children of a strumous habit, who are allowed more animal food than they can well assimilate. Occasionally crystals of lithic acid are found intermixed with these deposits, presenting the characters figured in Fig. 412.

Calculi.—The calculi that occur in this diathesis are of two kinds; the lithic acid, and the lithate of ammonia. The lithic acid calculus (Fig. 414) is usually of small or moderate size, varying from a pin's head to a pigeon's egg; it is oval, somewhat compressed and flattened, smooth on the surface, and of a fawn colour. On section it is seen to be laminated, and to present various shades of a light brown or fawn tint. The lithate of ammonia calculus is of very rare occurrence; when met with, it is chiefly in children, and is composed of concentric rings, having a fine earthy appearance, and being clay-coloured.

Treatment.—The treatment of the lithic acid diathesis must be directed to the removal of the prime causes of this condition, viz., mal-assimilation, defective oxygenation of the blood, and the ingestion of too large a quantity of stimulating food. All these may be remedied by attention to ordinary hygienic measures; the patient must live sparingly, should avoid fermented liquors, especially red and effervescent wines, and abstain from sweets, pastry, &c. He should take plenty of out-door exercise, and keep the skin



Fig. 414.—Lithic Acid Calculus.

in healthy action by warm dry air or vapour bathing, and the use of horse-hair gloves. The bowels must also be carefully regulated by means of saline and other aperients, with occasional alterative doses of Plummer's or blue pill; to which, if the constitution be peculiarly rheumatic or gouty, some colchicum may advantageously be added. A very good aperient for general use in these cases, is a drachm of Rochelle salt in an ounce and a half of the compound decoction of aloes, taken at night or early in the morning; or a dessert-spoonful of the following powder every morning;—*R Pulv. Rhe. ʒss., Potassæ tartratis, ʒi., Magnesiæ ustæ, ʒij., Pulv. Zingiberis, ʒj.;* *ft. pulvis.* The patient may also be directed to drink some of the natural alkaline waters, as those of Vichy or Fachingen. The Vichy waters, containing a large quantity of carbonate of soda, with free carbonic acid, are extremely serviceable for the correction of this diathesis. If they cannot be procured, a very good alkaline drink consists of a scruple of bicarbonate of potash and 5 grains of nitre dissolved in a tumbler of cold or tepid water, to which about 5 grains of citric acid, or a table-spoonful of lemon-juice may be added, and taken early in the morning or in the middle of the day.

When lithic acid calculus has actually formed, it is well not to give the alkaline remedies too long, or in too large quantity; lest the stone rapidly increase in size by becoming encrusted with phosphates.

OXALIC DIATHESIS.—This is characterised by the formation of oxalate of lime in the urine. It generally occurs in individuals in whom there is defective assimilation, dependent upon exhausted nervous energy, arising

from over-work, mental anxiety, or venereal excesses. The patient is usually pale and hypochondriacal, suffers from dyspepsia, acidity of stomach, and disturbed sleep. In these cases there is often loss of sexual power; a state of debility of the generative organs connected either with the want of erectile vigour, or too speedy emissions. The urine is usually very pale, abundant, and acid, and there is heat and smarting during its passage along the urethra. In this diathesis there is no sediment or gravel, properly speaking, but the crystals float in the

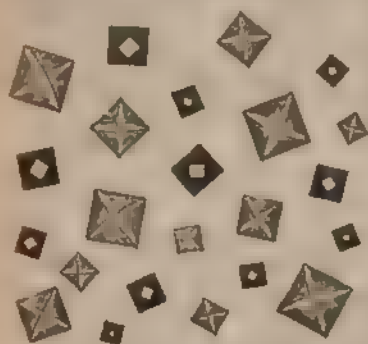


Fig. 414.—Oxalate of Lime.

urine; subsiding, however, when it stands, but not occurring in sufficient quantity to constitute a true sediment (Fig. 415).

Calculus.—The oxalate of lime or mulberry calculus is usually of a dark brown or almost black colour, moderate in size, being seldom larger than a walnut, and round; it is always rough, tuberculated, and sometimes almost spiculated on the surface (Fig. 416).



Fig. 416.—Oxalate of Lime Calculus.

Treatment.—When there is no calculus, it is necessary to put the patient upon a light and nourishing diet, especially fish, as recommended by Dr. Lind, cautioning him to avoid sweets and all fermenting liquors, with the exception of a moderate quantity of brandy. Tonics, particularly the mineral acids, iron, zinc, and quinine may be given, and the residence, if possible, be changed for a time to a warm climate. When calculus is formed, there is, owing to its roughness, and the irritable state of the patient's nervous system, usually a great deal of pain.

experienced in the region of the bladder, requiring the free administration of opiates.

PHOSPHATIC DIATHESIS.—This chiefly occurs in old persons, or in those who are prematurely aged, with a broken constitution and an anæmic condition of the system. In this diathesis, the sediment and calculi may occur in three distinct forms: 1. Triple or Ammoniac-Magnesian Phosphate; 2. Phosphate of Lime; and 3. Mixed Phosphates, consisting of a mixture of the preceding varieties.

1. The *Triple Phosphate* (Fig. 417) usually occurs in urine that is copious, pale, and barely acid, sickly to the smell, and soon decomposing and becoming very offensive. In other cases it is dark, alkaline, and mucous. This condition especially occurs in old people, and is associated with much debility, irritability of mind, pallor, and anæmia.

2. The *Phosphate of Lime* sediment is not of such common occurrence; it usually occurs in pale, and offensive, readily putrescent urine, mixed with much mucus, and in some cases apparently produced by the mucous membrane of the bladder.

3. *Mixed Phosphates* commonly occur after injuries of the spine, as the result of general impairment of the health, or in advanced cases of prostatic disease. They are occasionally met with in large quantity, forming a kind of mortar-like sediment in the bladder.

Calculi.—The phosphatic calculi are very common. The most frequent is the mixed, or fusible calculus, as it is termed, on account of the ready way in which it melts when exposed to heat. This calculus is friable, laminated, and has a chalky or earthy look. The calculus composed of phosphate of ammonia and magnesia is not so common; it resembles the preceding rather closely in its general characters, but is whiter and has a more chalky look. The phosphate of lime calculus is extremely rare; it is laminated, and harder than the other varieties.

Treatment.—The treatment of the phosphatic diathesis consists principally in improving the digestive powers, and in restoring the general strength of the patient by the administration of good food, wine, or beer. The exhibition of tonics, especially of nitric acid, should be attended to, and exercise in the open air enjoined. As there are usually much pain and irritability of system in this diathesis, opium may advantageously be administered.

Besides the calculi mentioned, various other kinds of concretions form in the urine, each of which doubtless represents a diathesis; the characters of which, however, are not so distinctly marked or so well recognised as those that have just been described.

XANTHINE, or XANTHIC OXIDE, was first noticed by Dr. Marcet, and has since been observed by Langier, Langenbeck, and others. It is of extremely rare occurrence, and has only been found in three recorded instances in the form of calculous concretions. These have generally been of small size, with the exception of the one removed by Langenbeck, which weighed 388 grains. For a detailed account of the chemical characters and constituents of this substance, as well as of the other materials of which

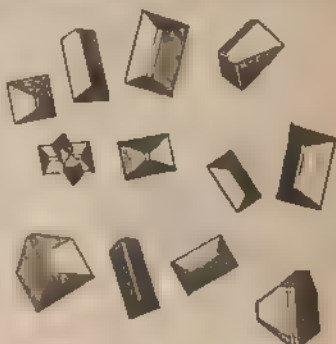


Fig. 417.—Ammoniac-Magnesian Phosphate.

calculi are formed, I must refer to the works of Drs. G. Bird, Beale Thudichum, &c.

CARBONATE OF LIME has occasionally been met with as an amorphous powder in alkaline or very faintly acid urine. I am not aware of any urinary calculus of this composition having ever been found; but Dr. Bird states that he has detected carbonate of lime as forming a distinct stratum in some phosphatic calculi; and Dr. Thudichum has examined prostatic concretions consisting almost entirely of this substance—the urinary origin of which, however, he doubts.

CYSTINE is one of the rarer forms of morbid product occasionally met

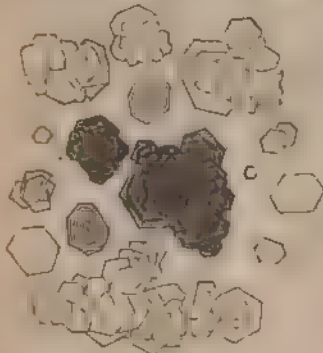


Fig. 418.—Cystine.

with in the bladder. It differs from all other ingredients in containing a large quantity—about 26 per cent.—of sulphur. It is very rarely seen as a sediment in the urine; but when it occurs in this form it presents the microscopic characters seen in Fig. 418, being composed of hexagonal laminæ. Calculi containing cystine have occasionally been met with. Dr. Golding Bird states that in Guy's Hospital Museum there are eleven composed of this peculiar animal matter, and in the Museum of University College we have some good specimens. Cystine in calculus has a peculiar yellowish or greenish and waxy look, very different

from any other ingredient met with in urinary concretions.

STONE IN THE BLADDER.

STRUCTURE OF CALCULI.—Calculi, though sometimes composed throughout of the same deposit, are not unfrequently made up of layers or strata differing in chemical composition from one another, and these usually go by the name of *alternating calculi* (Fig. 419). Most frequently the nucleus consists of lithic acid; next in the order of frequency comes the oxalate of lime; and then the concretions of a phosphatic character throughout. It is very seldom that the nucleus is absent; but concretions have occasionally been met with in which none could be detected, or in which it was even replaced by a cavity. The nucleus is usually as nearly as possible in the centre of the calculus and is generally pretty regular in shape; occasionally, however, it is branched or curiously radiated, and then the concretion generally affects a corresponding outline. Calculi containing two or three nuclei have sometimes been found

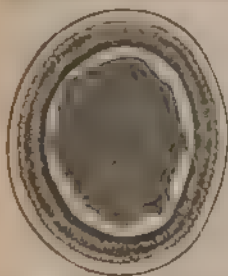


Fig. 419.—Section of an Alternating Calculus.

consisting probably of an equal number of concretions agglomerated together.

The body of a calculus having the uric acid nucleus is usually composed of some of the lithates; but not unfrequently these are overruled by a deposit of phosphates. In other instances, the body may be wholly composed of some of the earthy phosphates, which more rarely alternate with the oxalate of lime or the triple phosphates.

An oxalate of lime nucleus usually has a body of the same composition.

but in some cases it is incrustated by phosphates or urates (Fig. 420). When the interior is phosphatic, the concretion is always of the same constitution.

The alternations in the composition of a calculus are due to varying conditions of the general health, and consequently of the character and constituents of the urine, and of the state of the lining membrane of the bladder. The uric acid and oxalate of lime nuclei and layers are undoubtedly due to constitutional causes. The phosphatic laminae, whether interposed between the uric acid or incrustating the calculus, are probably chiefly dependent on vesical irritation consequent on the presence in the bladder of the previously formed uric acid or oxalate of lime nucleus.



Fig. 420.—Section of Oxalate of Lime Calculus incrustated with Phosphates.

ORIGIN.—Calculi may be formed either in the kidneys or in the bladder. Those that contain nuclei of the urates or oxalates are probably renal in their origin; whilst those that have a phosphatic nucleus are usually vesical from the first; renal nuclei of this composition being rarely met with.

All renal calculi—all those vesical calculi that have a renal origin, and some of those even that appear to be primarily formed in the bladder—have a constitutional source, arising from a morbid state of the urine, which probably in its turn depends upon mal-assimilation, the peculiar form of which determines the chemical composition of the stone. Those calculi that are formed by deposit from the urine upon and around some foreign body, as a pin or straw accidentally introduced into the bladder, and some soft phosphatic concretions that appear to be the result of an unhealthy state of its mucous membrane, may be looked upon as being local in their origin.

CALCULI OF RENAL ORIGIN.—When a stone forms in the pelvis of the kidney, it usually gives rise to pain in the loin. When of small size, it may descend into the bladder with but little suffering to the patient; but, if large enough to irritate the ureter and to pass with some difficulty, it then gives rise to a peculiar train of symptoms, which will immediately be described. In some cases the calculus attains a very large size, occupying the whole of the pelvis of the kidney, extending into the calices and ureter, and being moulded, as it were, to the shape of the parts amongst which it lies; it then gives rise, by its pressure, to absorption of the substance of the kidney, and occasions, by the magnitude that it attains, excessive pain and irritation in this region, the patient usually dying, worn out by constant suffering and by the irritation of incurable kidney-disease. In some instances, stone in this situation has given rise to abscess in and around the kidney, and has even been discharged through an aperture in the lumbar region.

Descent of a Renal Calculus.—In cases in which a renal calculus descends into the bladder, the patient is seized with pain in the loin that has been the seat of previous irritation. This pain is usually of the most agonising character, extending into the cord and testis, and down the inside of the thigh of the affected side. There is retraction of the testicle, with constipation and vomiting; frequently accompanied by the passage of scanty, high-coloured, and bloody urine, and great constitutional disturbance. This pain usually continues of a somewhat remittent character, until the calculus enters the bladder, when, unless expelled, it gives rise to the train of symptoms peculiar to its presence in that organ.

Treatment.—During the descent of a renal calculus, which always occupies many hours, and perhaps some days, the patient should have full doses of opium administered, be put into a warm hip-bath, and have mustard

poultices applied to the loin, or be cupped in this situation, if necessary the bowels should also be thoroughly emptied by enemata. It is well to bear in mind, that a somewhat similar train of symptoms to that caused by the descent of the calculus, may be excited by some forms of irritant or flatulent distension of the cecum and descending colon, which will require appropriate treatment.

CALCULI OF VESICAL ORIGIN.—Though vesical calculi often owe their origin to the descent of a stone from the kidney, yet it frequently happens that there is no evidence of their coming from such a source, but their appearance of their being deposited in the bladder; a nucleus being originally formed in this viscus by the aggregation of some substance matter, around and upon which fresh deposits take place, until a true calculus is formed. In some instances, vesical calculi have been found deposited upon and incrusting foreign bodies, accidentally introduced into the bladder, such as a piece of straw, a pin, a bit of bougie, &c.

NUMBER.—The number of calculi in the bladder varies considerably; most commonly only one is encountered; but in about one fifth of the cases operated upon, several will be found; from two to six or eight are by no means uncommonly met with. Occasionally several dozens have been detected; and there are even instances on record in which several hundreds of distinct and separate calculi have been found in one bladder. The most remarkable case of this kind is one in which Dr. Physick removed from a judge in the United States upwards of a thousand calculi, varying in size from a partridge-shot to a bean, and each marked with a number. Several calculi may become matted together in one large concretion, as in the annexed representation of a calculus (Fig. 421) that I removed from a



Fig. 421—Calculus matted together.

child four years old; it was formed of eleven distinct acid calculi soldered together in this way; besides which, three others were lodged in the bladder. When several more calculi occur, it is remarkable how uniform they are in shape, size, and weight, one being the exact counterpart of the other.

When there are several calculi in the bladder, the attrition of one against the other usually causes the opposing surfaces to become smooth, thus constituting "facets" (Fig. 422). In some cases, however, when the calculi are numerous, there are no signs of attrition. In



Fig. 422—Calculi with Facets.

a patient of mine who had fifteen calculi in his bladder, all the stones were round, about the size and shape of marbles, without any facets. In other cases, again, there may be more facets on one calculus than companion-calculi in the bladder. A second stone may occasion two or three facets on the first, having rubbed first to one and then to the other side of it.

Spontaneous Fracture of a calculus will sometimes occur within the bladder. This curious phenomenon may happen to a stone that is adherent, or to one among several calculi. When it occurs, great irritability of the bladder is set up. There are several ways of explaining this fracture, or rather disintegration, of a calculus. Civiale supposes it to occur by the contraction of the hypertrophied coats of the bladder upon the stone. It is possible that, when there are several calculi in the bladder, the concussion of one against another may give rise to it, and for the breaking

up of a calculus to happen, it would by no means be necessary that this pressure of the bladder or concussion should be sufficiently strong to resolve the stone at once into fragments. If a crack or fissure merely be formed in it, the infiltration of the urine into this may so soften and loosen its cohesion, that it becomes resolved without further violence into a number of pieces. In some instances these become agglomerated together, by the deposit of a quantity of phosphatic matter upon and around them. In other cases, the different fragments may each form the nucleus of a fresh calculus, so that the bladder may afterwards contain numerous concretions.

PHYSICAL CHARACTERS.—The *Size* of calculi varies from that of a hemp-seed or pin's head to a concretion of immense magnitude. One of the largest with which I am acquainted, is a calculus removed by the high operation by Dr. Uytterhoeven of Brussels, which I saw some time ago in his possession, and of which he has been obliging enough to give me a cast; it is of pyriform shape, and measures $16\frac{1}{2}$ inches in its longest circumference, and $12\frac{1}{2}$ inches round at its broadest part, being $6\frac{1}{2}$ inches long, and about 4 wide. In the celebrated case of Sir W. Ogilvie, Cline attempted, but failed, to extract a calculus measuring 16 inches round one axis and 14 round the other. It weighed 44 ounces, and must have been of about the size of Dr. Uytterhoeven's. These enormous concretions are happily rarely met with at the present day; the usual size of stones removed by operation being from about one to two inches in the longest diameter, somewhat narrow, and perhaps flattened.

The *Weight* of calculi commonly varies from a few grains to several ounces; the commonest size is from three drachms to about an ounce or two in weight, occasionally from three to six; from this they may range upwards until several pounds are reached. Thus, in Cline's case the stone weighed 44 ounces, Deschamps saw one of 51 ounces, and Morand one weighing 6 lbs.: none of these admitted of removal. The largest calculi are usually composed of phosphates, in greater part if not in whole. Large and heavy calculi are certainly less frequently met with now than formerly, owing to operations for stone being simpler and less dreaded since the introduction of anaesthetics, and hence practised in an earlier stage of the disease.

The *Hardness* of calculi varies considerably; the oxalate of lime is the hardest; the lithates come next in consistence, and are often very hard, though brittle; the phosphatic calculi are always comparatively soft and friable.

The *Shape* of calculi presents great variety; most commonly, however, they have an ovoid figure. Concretions of urate of ammonia and uric acid are generally pretty regularly ovoidal, smooth, and disc-like. Those composed of oxalate of lime are usually somewhat globular or square-shaped, and generally rough, nodulated, or spiculated upon the surface. The phosphatic calculi present usually the most irregular outline; most commonly, it is true, they are ovoid or globular, but are not unfrequently branched, as if moulded to the interior of the kidney, constricted, or of an hour-glass shape. The cystine calculi are generally tolerably oval and regular in outline.

Position.—Most frequently calculi lie loose in the bladder; but occasionally they may be fixed, either by being encysted, and then lying in one of the sacculi that have already been described within the walls of the bladder (Figs. 423 and 424); or by being fixed in and embraced by one of the ureters; and in other cases by being deposited upon, and partly included in, fungous growths.

CAUSES.—Whenever a foreign body of any kind, as a piece of broken catheter, &c., is introduced into the bladder, it will form the nucleus of a calculus, speedily becoming incrustated by calculeous, probably phosphatic matter. But the causes of calculi occurring spontaneously are very obscure. There can be little doubt, it is true, that the different forms of concretion are connected with the varieties of diathesis that have already been described, and we may look upon the formation of a calculus as an indication of the



Fig 143.—Exterior of Bladder, containing an Encysted Calculus at x



Fig 144.—Interior of the same Bladder, showing a small Orifice leading into Cyst at a

existence, in a greater degree of intensity than usual, of the causes which ordinarily give rise to sediments or gravel; but why, in particular cases, aggregation into a calculeous mass takes place, it is impossible to say.

Age exercises considerable influence upon the production of calculi. Stone may occur in the bladder at all periods of life, and even, according to Stahl, may be congenital. The greatest number of cases occur during the first two decennial periods; thus Thompson, as the result of his statistical enquiries, states that one-third of the entire number of cases occur before seven years of age, and one-half of the entire number before the thirteenth year is completed. Coulson has collected 2972 recorded cases of lithotomy from various sources; of these, 1466 occurred under the age of ten, 731 from eleven to twenty, 205 from twenty-one to thirty; 264 from thirty-one to fifty, and 306 from fifty-one and upwards. In many of these cases, although the patient was cut towards the middle period of life, the stone probably began to be formed during childhood.

Sex influences materially the occurrence of stone, which is far more frequent in the male than in the female, in the proportion of about twenty to one of cases requiring operation. This, however, does not represent the exact ratio; as, owing to the shortness and large size of the urethra in females, many small calculi are voided by them that would be retained in the male.

It would appear that in some parts of the world calculi is a far more common disease than in others. It is generally more frequently met with in cold than in warm climates. The Negro race is remarkably exempt from this affection. It is a singular fact that in some parts of the same country calculous disorders are of far more frequent occurrence than in others. Thus it is well known that the inhabitants of the east coast of England and Scotland are peculiarly liable to these disorders; and that in Norfolk it occurs with especial frequency, this district furnishing, in all probability, as many cases as the half of the rest of England. In America also, it would appear that the inhabitants of certain States are peculiarly liable to the

affection; and I understand that in some districts of Germany the disease may be said to be almost unknown, whilst in others it is of common occurrence. The relative frequency of the kinds of calculus also varies in different countries. Dr. H. V. Carter, who has analysed and described upwards of a hundred specimens contained in the Museum of the Grant Medical College at Bombay, shows that the percentage of calculi with an uric acid or urate of ammonia nucleus is in India, 56·30; in England, 71·79; while that of calculi with a nucleus of oxalate of lime is in India 38·65, in England 16·87. The calculi composed purely of oxalate of lime also greatly exceed in number those which consist entirely of uric acid or urate of ammonia. To what these differences are owing, it is impossible to say. Peculiarity of race, of constitution, and of diet, with exposure to prevalent easterly winds, have all been assigned as reasons for them; but probably not on very sufficient grounds.

SYMPTOMS.—The symptoms of stone in the bladder vary according as the calculus lies loose in the cavity of the viscus or is encysted. Their intensity will depend on the size and shape of the stone, the condition of the bladder, and the constitution of the patient. Most commonly, the severity of the symptoms is in proportion to the magnitude of the calculus. This, however, is not always the case. In a patient whom I once cut, the most intense suffering and repeated attacks of cystitis had been occasioned by a small but sharp-pointed calculus, not weighing more than a drachm; and some years ago I saw a patient in whose bladder five calculi were found after death, nearly as large as chestnuts, though their presence had never been suspected during life by the different surgeons under whose care he had been for stricture, so little distress had they occasioned. In some cases, the symptoms of stone very suddenly declare themselves; and then the surgeon finds on examination that the patient has a large calculus, which must have been a long time forming without attracting attention. Rough and angular calculi necessarily give rise to more severe symptoms than smooth ones, owing to their inducing a chronic form of cystitis; and, as the constitution is usually a good deal shattered and the nervous system very irritable in those conditions of the system in which the phosphates are deposited, phosphatic calculi are usually attended by more local suffering and constitutional disturbance than other forms of the disease.

The symptoms induced by stone are the result of the mechanical irritation produced by the presence of a foreign body in the bladder; they consist of Pain, Increased Frequency in Micturition, occasional Stoppage of the Urine, and Various Morbid Conditions of that Fluid.

The Pain in calculus is often the first symptom that attracts attention; it varies greatly in character and degree. It may not only be experienced in the region of the bladder and the perineum, but may radiate widely in the course of the sacro-lumbar nerves, the patient complaining of a heavy and dragging sensation in the groins, extending down the outside or back of the thighs, and not uncommonly experienced even in the soles of the feet. The penis is the seat of a good deal of uneasiness; frequently of a sharp and cutting pain at the end of the glans. This is especially noticed in children, in whom attention is often attracted to the complaint by their constantly squeezing and pulling the organ to relieve the distress they suffer in it. The pain is much increased by any movement by which the stone is jolted about in the bladder, as in driving, riding, or jumping; and is especially severe in those cases in which cystitis occurs. It is always most severe towards the termination of, or immediately after micturition, as there is then a tendency for the calculus to roll forwards towards the neck of the

bladder, where it comes into contact with and is grasped by the most sensitive part of that organ. Hence it is not unfrequent, in cases of calculus in children, to find that the little patient instinctively lies upon its back or on its side whilst passing urine, and thus escapes much of the agony that it would otherwise suffer. In adults in whom the prostate happens to be enlarged the calculus usually lies in a depression behind this gland; and hence, being prevented from coming into contact with the neck of the bladder, occasions less suffering than in other cases.

In consequence of the irritation set up in the bladder occasioning chronic inflammatory action of the mucous membrane, there is an *Increased Frequency of Micturition*. The urine is passed frequently, in small quantities at a time, and usually contains some mucus or pus, and is occasionally tinged with blood or loaded with thick vesical mucus. But in many cases the urine remains remarkably clear, transparent, and free from marked admixtures throughout. If the kidneys be irritated, the urine is commonly albuminous. The presence of blood in the urine is often one of the earliest signs of stone in the bladder, and in children especially should lead to the suspicion of the existence of calculus. It may be in large quantities, and may continue for many weeks, especially in the earlier stages. The urine may then clear as the bladder becomes accustomed to the presence of the stone, and only reappear upon the influence of active movement, or of any cause of increased irritation of the organ. It very rarely happens that a stone has existed for any time, without the urine becoming occasionally streaked or tinged by blood.

An occasional *Stoppage in the Flow of Urine* before the bladder is empty commonly occurs, owing to the stone being impelled against its neck, and thus blocking up the urethra; but, on the patient lying on his back or on his side, the stream flows again, the situation of the calculus being changed.

As a result of the straining and general irritation about the genito-urinary organs, *Prolapsus of the Anus*, accompanied by *Tenesmus*, is by no means uncommon, especially in children; and in some cases there is very troublesome *Priapism*.

When a stone is *encysted*, those symptoms that depend upon its being loose and rolling about in the bladder, are necessarily absent; thus there is no stoppage of the urine, this fluid is seldom bloody, and the pain is materially increased by jolts and rough movements, though there are seldom any pain in the usual situations, and increased frequency of micturition from the pressure and irritation of the calculus.

PHYSICAL DIAGNOSIS OF STONE.—The existence of stone is finally determined by *Sounding the Bladder*.

A *Sound* is a solid steel instrument shaped like a catheter, but shorter, and with a more pronounced curve (Fig. 425), so that it may explore thoroughly all parts of the bladder,

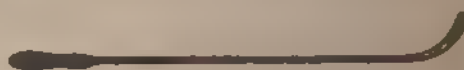


Fig. 425.—Sound for examining Bladder

especially those behind the prostate. It should have a wide and smooth handle and be slightly bulbous. The operation of sounding is conducted as follows. The patient lies upon his back on a hard mattress, a full bladder is sound well oiled and warmed is then passed into the bladder, which should, if the patient can retain it, be allowed to contain three or four ounces of urine. The surgeon then using his left hand, or crossing over to the patient's right side, whichever he finds most convenient, carefully directs the head

the instrument towards the back of the bladder, turning it from right to left over the whole of that region, as shown in the following cut (Fig. 426); he next draws it forwards on one side as far as the neck, tapping as it were gently with its beak; he repeats the same manoeuvre on the other side; and, lastly, directs the end of the instrument by raising its handle into the lower fundus, which he carefully explores. Usually the stone is readily detected by these manoeuvres, and its position in the bladder will often be dependent upon, and may to a certain extent be taken as an approximative indication, of its size.

Thus, when moderately large it will usually be found lying to one side, most generally the right, of the neck of the bladder; when small, it will be placed towards the fundus, near the orifice of one or other ureter. These then are the situations in which the surgeon should first seek for a stone, and in which

he will generally find it when present. Should it not be met with here, the chances are, more especially if the patient be elderly, that it will be found in a pouch behind the prostate, where it may be detected by raising the handle and so depressing the beak of the sound. Should the surgeon not detect the calculus in any of these situations, he depresses the handle between the thighs, and tilts up the beak so as to examine the pubic portion of the organ (Fig. 427). In the event of his not meeting with a stone, he may direct the patient to stand up, and then explore the bladder, first upon one side, then on the other. Should the rational symptoms of stone be well marked, though no calculus be struck, the surgeon must not give a decided opinion in the negative after the first exploration, but should examine the patient again a few days later,

with the bladder in different states as to its contents. In making this second examination, I have found it of great service to use a hollow steel sound, by which the organ can be injected or emptied at pleasure (Fig. 428). The patient



Fig 426.—Sounding for Stone behind Prostate



Fig 427.—Sounding for Stone above Pubes.



Fig 428.—Hollow Sound

should on this occasion have his bladder injected through such an instrument as this, with four or six ounces of tepid water, so as to distend the organ.

slightly, and prevent the folds of mucous concretion that may exist in it. Its interior way already described, and, if the stone can of the bladder are gradually allowed to exit, the patient is desired to stand up whilst the examination is made. In this way, by examining a patient in different conditions of the bladder as to capacity, and position, the existence of a stone may be ascertained. A lithotrite may occasionally be used for the detection of small calculi lying behind the bladder, more readily reached by its short beak than by the lithotome. These examinations must not, however, be continued for more than five minutes, lest the bladder should be injured. If the stone is struck by the sound, there is not only a click communicated to the instrument, but there is a vibration which can be detected by the by-standers, as well as by the surgeon.

By conducting the sounding properly, the surgeon can not only determine the existence of a stone, but its position, whether single, if it be encysted, and the general character of the stone, which it is of importance that he should be able to determine before any operation. A good deal of this information can be obtained by ordinary sounding, but some of the points can be ascertained by sounding with the lithotrite.

The hardness of the stone may usually be ascertained by the clear ringing character of the click; a lithic stone giving a sharper sound than a phosphatic one.

A calculus may generally be known to be present by the times, but not at others (Fig. 429); if the

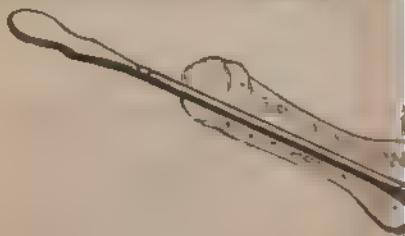


Fig. 429.—Sounding for Stones.

stone is in one situation; and if the beak of the instrument is applied to it, so as to isolate it, but feel a kind of tumour in the bladder, around or on one side of the prostate.

The fasciculated, roughened, and sacculated stones are generally detected by the way in which the instrument is moved and rubs over the organ.

The size of the calculus is best determined by the way in which the instrument is moved. A surgeon may sometimes come to a decision as to the size of the stone, by observing the extent of surface along which the instrument is being withdrawn. It can be arrived at in this way; and I have known surgeons deceived in their estimate of the size of the stone, when several small ones lying together for

lithotrite and seizing the calculus gently between its blades, a correct estimate of its size may always be arrived at.

In order to determine that several *calculi* exist in the bladder, it is sometimes sufficient for the surgeon to feel that the beak of the sound comes into contact with a stone on each side of the organ, or that it can be distinctly insinuated between two concretions. In some cases, however, these points cannot clearly be made out; and then the surgeon, introducing a lithotrite and seizing the first calculus with which he meets, should hold this between the blades of the instrument, and whilst it is so fixed move it and the lithotrite from side to side; when, if a click be heard and felt, he may be sure of the existence of another stone.

Mistake in Soundings occasionally occur. The surgeon may mistake a hardened and fasciculated bladder, having its ridges perhaps incrustated with sabulous matter, for a calculus; this is especially apt to happen in children. In these cases, however, the mistake may usually be guarded against by the absence of a distinct click, though a rough grating sensation be experienced, and by the surgeon being unable to isolate a stone. Yet the difficulty in some cases is great; Velpeau states that he is acquainted with four instances, and S. Cooper with seven, in which patients have been cut and no calculus found; and when we reflect that these accidents have happened to such men as Cheselden, who on three occasions cut a patient and found no stone; to Crosse, to Roux, and to Dupuytren, it is easy to understand that in some cases the difficulty of coming to a correct decision must be very great.

In women the symptoms of stone closely resemble those met with in men, and the detection of the calculus is usually very easy, owing to the shortness of the canal and the facility with which the stone may be tilted up by introducing the fingers of the left hand into the vagina. The sound used in these cases should be shorter and less curved than that employed for the detection of calculus in the male bladder.

PATHOLOGICAL CHANGES INDUCED BY CALCULUS.—After a stone has existed for some time in the bladder, it induces serious pathological changes in the whole of the urinary apparatus. The *urethra* usually becomes slightly dilated; and the *prostate* not unfrequently somewhat enlarged and irritable, in consequence of which a kind of pouch is formed behind it, in which the calculus is apt to lodge. The most important changes, however, take place in the bladder and kidneys. The bladder becomes extremely sensitive, especially about its neck, and is consequently unable to contain as much urine as usual; hence it becomes contracted. In some rare instances, however, as will be more especially noticed when we come to speak of lithotrity, it falls into an atonic condition, and then is apt to become rather largely dilated. The mucous membrane is commonly a good deal inflamed and irritated by the presence of the calculus; and the muscular coat becomes thickened and hypertrophied, so as to give it a very fasciculated or columnated appearance. Cysts occasionally form, containing sabulous matter and fetid pus or urine, and in some cases lodging a concretion, which then constitutes an encysted calculus lying altogether outside the cavity of the bladder, with which it merely communicates by a very narrow aperture, as in Figs. 423 and 424, representing a case that was under my care some years ago, and which is fully described in the Journals for March, 1853. The *kidneys* are usually irritated, often congested, frequently in a state of granular degeneration, and ultimately become the seat of such structural changes as are incompatible with life. When death occurs as the consequence of stone, the patient usually sinks, worn out by protracted suffering and kidney-disease.

LITHOTOMY

It is not my intention to enter into the operation that has been practised from the of the gradual modifications that have ad from the rude attempts of the Greek and and unscientific procedures adopted by the revival of letters. For all this, I would refer of Deschamps and of John Bell. The operation this country, is essentially that introduced or less according to the views of particular generally are agreed upon the great principles carrying these out ; as in the direction and instruments employed, which have been in views of particular operators. But, although tion, as modified and practised by Liston, and safest mode of cutting for the stone, no doubt that recourse may occasionally be taken by other methods instead of it. Indeed, there is no question as to the size, shape, and position of the stone ; the object of all is to render it desirable, and indeed necessary in every case. Hence, a surgeon should not be too rigid but should adopt one or other of the methods according to the exigencies of the particular case.

INSTRUMENTS.—The table for operating should be at such a height, so that when the surgeon sits on a stool he will be on a level with his breast ; a few towels should be upon the table, and covered by a piece of oil-cloth, and a tray of sand placed under it on the floor. The instruments are the following :—a pair of lithotomy forceps, a scalpel, a staff, forceps, and scoops of various sizes. There may be added a searcher, and a brass injector.

The *tapes* should be of coarse flannel, and about 12 inches broad.

The *scalpel* for the adult may be of the straight kind (Fig. 430) ; for children, it may be made of the curved kind (Fig. 431).

Fig. 430.—Lithotomy
pointed lithotomy-knife of the size and shape of the hand (Fig. 431).

Fig. 431.—Probe pointed

The *staff* should have a deep groove on the back, so that the third of the instrument, it should be well rounded, so that the urethra will admit, and have a roughened surface to prevent it from slipping.

The *forceps* must not be too heavy, but strong enough to hold the handles, and have the joint well set back so that the blades may be brought

recommended by Liston, should be lined with linen to prevent the stone from slipping (Fig. 433). Mr. Coxeter has made them with open blades, but lined with linen as heretofore (Fig. 432); in this way, as there is less



Fig. 432 — Open bladed Lithotomy Forceps.

metal, the weight is diminished, and the diameter of the instrument with a stone in its grasp is materially lessened. The ordinary forceps are straight, but it is advantageous to be provided with some that are curved (Fig. 434). The handles should be made with a loop on one side and a ring on the other; the ring for the reception of the thumb should be placed somewhat obliquely. The *scoops* of different sizes, and curved, can most conveniently be used when fixed in a roughened handle (Figs. 435 and 436). The *tube* should be of gum-elastic, well rounded at the end, and provided with silver rings. The *searcher* is a slightly curved sound, having a bulbous extremity (Fig. 438). The *syringe* presents nothing peculiar.



Fig. 433 —
Forceps.

Fig. 434 —
Curved Forceps.

Fig. 435 —
Scoop in Handle.

Fig. 436 —
Scoop.

Fig. 437 —
Tube.

Fig. 438 —
Searcher.

In describing the operation of lithotomy, we shall first of all consider *seriatim* the different steps of an operation that presents no unusual complication or difficulty; we shall then consider the difficulties that may be met with, and the accidents that may occur during the operation, and the principal sources of danger and the causes of death after its performance.

PREPARATION OF THE PATIENT.—Before subjecting a patient to operation, his general health must be properly attended to; and, indeed, if we find the constitution much broken by prolonged suffering, the bladder or kidneys seriously diseased, as indicated by the existence of pus or albumen in large quantity in his urine, it will be wise to postpone the operation for a time, or perhaps even to defer it altogether. There are few conditions in which a surgeon is placed, that test his moral courage more severely than the refusal to operate on a patient for stone, and thus allowing him to die unrelieved.

For a surgeon to do this, unmoved by the his friends, requires no little self reliance. emaciated, his constitution broken down, organised extensively, lithotomy would be rapidly fatal result, and the performance of act of cruelty. Supposing, however, that the urine is either healthy or contains but albumen, that there is no visceral complication of the operation, and that the patient's health will only be necessary to subject him to pre short time, so as to allay or remove irritability proceeding with it. With this view he should for about a week or ten days preceding the properly regulated, but not be of too low a level by the administration of opiates or henbane. On the day preceding the operation, a di aperient should be administered; and on the rectum must be emptied by means of an enema.

LATERAL OPERATION.—All the urine has been drawn off, that organ should be filled with eight ounces of tepid water, in order to steam and extraction of the stone. After chloroform the surgeon should introduce a full-sized staff, in order to feel for the calculus. If he detects it; if he cannot detect it, it is usually recommended to draw the staff and introduce a sound, with and, in the event of his still failing to detect the operation must be deferred, for it is that lithotomy should never be performed at the time when the patient is actually on the not to proceed with the operation unless the staff; lest the point of this, though appar



Fig. 459.—Position of Patient and Line of Incision for Lateral Lithotomy

stiffened by chronic rheumatic arthritis; but particular difficulty in the operation, though in position of the limb. The surgeon then, se

shaves the perineum—if this have not already been done—and introduces his finger into the rectum to ascertain that the gut is empty. He then gives the staff into the charge of a trusty assistant, who stands on the patient's left, and who raises and draws aside the scrotum with the left hand whilst he holds the staff in the right (Fig. 439). The surgeon then sees that the staff is held in the way in which he prefers it. There are two ways in which it may be held; it may either be drawn well up into the arch of the pubes, or it may be pushed somewhat down, and slightly turned towards the left of the perineum. Liston always employed the first method, which I certainly think is the best, as it tends to increase the space between the urethra and the rectum, and consequently lessens the danger of wounding that gut, which more than counterbalances the advantage of the other method—that of approaching the membranous portion of the urethra to the surface.

The external incision is made by entering the knife in the raphe of the perineum one inch and a half above the anus, and carrying it downwards and outwards, until it reaches a point that is just below the anus, but about one-third nearer to the tuberosity of the ischium than to the margin of the anal aperture (Fig. 439). It is useless to prolong the incision beyond this, as any freer division of the structures of the scrotum and on the nates cannot facilitate the extraction of the stone; but it must occupy the extent indicated, otherwise considerable difficulty may be experienced in the later steps of the operation. The depth to which this incision should be carried must vary according to the obesity of the subject; usually from about three-quarters of an inch to an inch, but not so deeply above as below. By this incision

the skin, superficial fascia, and subcutaneous fat are divided. After it is completed, the knife is again introduced a little below the upper part of the wound, and the blade is run lightly downwards over any resisting structures; the left fore-finger being placed at the middle of the wound, so as to protect the rectum. In this way the transversalis perinei muscle is divided, together with some cellular tissue and small vessels, and the triangular space is opened between the accelerator urine and erector penis muscles; the knife is then withdrawn, and the left index finger is pushed



Fig. 440—Lateral Lithotomy: Finger in Groove of Staff

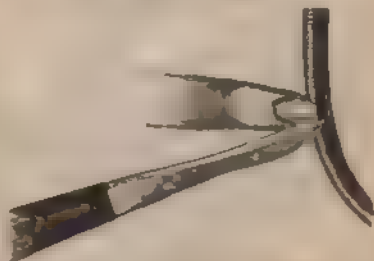


Fig. 441—Knife in Groove of Staff

deeply into this space until the edge of the nail is lodged in the groove of the staff (Fig. 440), which can be felt just anterior to the prostate, then covered by the membranous portion of the urethra. The point of the knife is then pushed through the urethra at its membranous part into the groove of the staff, above the index finger, which protects and presses to the right the rectum lying beneath it (Figs. 441 and 442).



Fig. 442.—Second Stage of Lithotomy.

When the knife is felt to be well lodged in the groove, its handle is slightly depressed, so that the point may be raised; at the same time the blade should be somewhat lateralised, so that its side lies parallel to the ramus of the ischium. The edge be turned too directed downwards towards the mesial line the rectum may be wounded, if it be directed too much outward the internal pudic artery will be endangered (Fig. 443), hence the course is the proper one.



Fig. 443.—Arteries of Perineum and Deep Fascia. The surgeon, keeping the knife steadily in this position, and pressing the point firmly against the side of the groove of the staff, which he must never for a moment let go, pushes it forwards through the deep perineal fascia, a few fibres of the levator ani, and the prostate, and thus makes an entry into the bladder.

(Fig. 442); he then withdraws the knife by keeping its back against the staff, so as not to enlarge the extent of the incision in the prostate. Through this, and along the staff, he then pushes his left index finger until it reaches the bladder, when he endeavours to feel the calculus with its tip. Should his finger be short, the perineum deep, or the prostate enlarged, he may be unable to reach the bladder in this way; and must then introduce a blunt gorget, as recommended by Cheselden and Martineau, in order to dilate the aperture in the prostate. If he use his finger for this purpose, he gives it a twist or two after passing it through the prostate, so as to expand and dilate the aperture through which it is entered. Having made sure that it is in the bladder, and having, if possible, felt the stone, he directs the assistant to withdraw the staff from the urethra.

Here let us pause, and examine the principal points in these the first and second stages of the operation. It will be observed that, in accordance with the best authorities upon this subject, and with my own experience, I have recommended the external incision to be free, the rectum to be protected by the left index-finger, the knife to be somewhat lateralised during and after the opening of the urethra, and the deep incision to be limited.

1 The *position of the knife* must be carefully attended to, especially during the deep or second incision. At this stage of the operation the edge should be *lateralised*; that is, directed about midway between the horizontal and perpendicular positions, so that the surface of the blade lies nearly parallel to the ramus of the ischium. The manner of holding the knife has been much discussed, and necessarily and naturally varies with different surgeons. I believe it signifies little how the handle of the instrument is held between the surgeon's fingers, provided the edge is never turned upwards, but is always kept well lateralised, and the point steadily pressed into the groove of the staff.

Provided a surgeon knows what he is about, he may safely hold his knife as best suits his own convenience. In the first incision, most operators, I believe, hold the knife *under* the hand, as represented in Fig. 444; a position which that excellent lithotomist and accomplished surgeon, Ferguson, preserves throughout the operation. Liston, in the early part of his career, appears to have held the knife, in the second stage of the operation, *above* the hand; and in all the representations, published as well as unpublished, that he has left of his operation, he has depicted the knife and hands in the position shown in Fig. 445; which in the last edition of



Fig. 444.—Position of Hand and Knife
(Ferguson).



Fig. 445.—Position of Hand and Knife
(Liston).

his *Practical Surgery*, he describes as a correct sketch of "the position of the hands and knife" at the commencement of the second stage of the operation. There can be no doubt, however, as Ferguson has pointed out, that in actual practice, at least after his first few years as an operator,

he held the knife under the hand, with the index-finger upon the outer back of the blade.

For my own part, I believe that every surgeon will hold the knife in a way which he finds most convenient, and, as it were, natural to him. If any rules can be laid down on this point, I should say that, in operating on a child, or on an adult with a shallow perineum, the knife is most conveniently held as represented in Fig. 444. But if the patient be fat, and the perineum deep, then I think that it is a question whether greater success may not sometimes be secured by holding the knife somewhat in the manner of a gorget, with the index-finger, perhaps, a little more upon the side of the handle (Figs. 442 and 446); in this way the point is firmly pressed into



Fig. 444 - Position of Hand and Knife (Author)

downwards. No danger can result in the deep incision from pushing the point of the knife up into the groove of the staff; but there is great danger of missing the bladder, and entering the recto-vesical space, if it be at all depressed and the handle raised, though this cannot always be avoided if the staff be pushed deeply into the bladder.

2. The incision into the prostate in the adult should be of very limited extent: on this point, I believe, all surgeons of the present day are agreed. Scarpa advises that the incision into it should not exceed five lines in adults, and two in children. It is difficult to measure the extent of the incision; it is sufficient to say, that it should be as limited as possible, and if care be taken to push the knife in, with the point well pressed against the prostate, and the blade forming but a limited angle with the shaft of the staff, and especially in withdrawing it that it be brought carefully back over the finger and still in contact with the instrument, there will be no danger in cutting too widely, or in doing more than merely notching the apex of the prostate (Fig. 447, a). The danger, however, it must be borne in mind, does not



Fig. 447 - Incision in Prostate

consist in the section of the prostate itself—which is a reality a structure of but little importance—but a cutting beyond it into the reflections of the prostatic fasciae, which will be opened up if the base of the prostate be cut, and the wound of which will, almost to a certainty, be followed by urinary extravasation and diffuse inflammation.

In the section of the prostate, then, two points have specially to be attended to: one is, that the knife in entering be not pushed forwards at too great an angle with the staff, so as to cut widely; and the other is, that

in its withdrawal the blade be kept steadily in contact with the staff. Indeed, I believe that there is more danger of doing mischief in the withdrawal than in the entry of the knife; for, if it leave the staff for a moment, all guide is lost, and the edge may sweep downwards through the base of the prostate and its investing capsule. As the knife is withdrawn, the left index-finger is pushed forwards into the aperture in the prostate, which is then dilated by its pressure to a sufficient extent for the introduction of the forceps, which are slipped in as the finger is withdrawn, and for the extraction of the stone. This part of the operation may very conveniently be performed, as was usually done by Liston, at the moment when the surgeon is stooping down, engaged in selecting his forceps. The dilatation of the prostate is readily effected; for this structure, though dense, is friable, and breaks down easily under somewhat forcible pressure by the finger. In this way, by a mere notching of the prostate,—by a slight section of its apex or urethral surface, followed by simple dilatation with the finger,—sufficient space will be obtained for the extraction of all moderate-sized calculi, without the employment of any violence, or the infliction of any bruising upon the tissues.

But another obstacle exists which will prevent the dilatation of the neck of the bladder to any very material extent, without an amount of bruising, or laceration, or even rupture that would probably prove fatal to the patient. This obstacle consists of a firm resisting tissue, which has been described by Tyrrell as “an elastic ring,” surrounding the neck of the bladder; by Liston, as “a fibrous or ligamentous band surrounding the orifice of the bladder, into which the muscular fibres of the organ are inserted.” If this ring or band be ruptured, either by the finger or by the expansion of the forceps, fatal consequences will ensue; but if it be divided, the other tissues, as Liston observes, will yield to an inconceivable extent, without injury to the tho-vesical fascia. The division of this ring must only be practised to a very limited extent. I believe that it is always effected in the act of pushing the scalpel inwards into the bladder; a mere notching of the fibres of the ring, indeed, is sufficient to allow the requisite expansion to take place when pressure is applied.

In thus describing the mode of incising the prostate and neck of the bladder, I have, generally, used the term “dilatation;” and I believe that, by a simple process of dilatation or expansion of these parts, and without any violence whatever, small calculi of or under an inch in diameter may be extracted. In fact, for the removal of such stones, no force whatever is required, either in opening up the prostate or in withdrawing the calculus. But, in removing stones of greater magnitude than this, I believe that the process of expansion of the prostate and neck of the bladder, whether effected by the finger, by a blunt gorget, or by the opening up of the blades of the forceps, is a process of laceration rather than of dilatation, as I have frequently had occasion to observe in experiments on this point made on the dead subject. This laceration is, however, confined to the substance of the prostate, and does not extend through its capsule, and into the fasciæ of the pelvis. Indeed, it is extremely difficult, nay, almost impossible, with any ordinary force, to lacerate the dense fasciæ reflected over the prostate, which, like other aponeurotic structures, scarcely admit of being torn. This structure, therefore, remains as a firm unbroken barrier between the pelvic fasciæ and the external wound, preventing the possibility of the infiltration of urine into the internal subperitoneal cellular tissue, and lessening materially the chance of the extension of diffuse inflammation into the pelvic fasciæ.

Extraction of the Stone.—A pair of forceps of size proportioned to that of the calculus, and in tepid water, must be slid along the incision, and by which the neck of the bladder is fixed by the point of the finger, and it is moved. The forceps having been introduced, when a gush of urine will usually take place, and fluid have not already escaped at the time of the prostate. By this gush the calculus is sometimes be carried into the grasp of the instrument. The stone requires to be felt for with the index finger, as has been ascertained, usually at the inferior opening are opened; and, by pushing one again, giving it a slight shake, the calculus generally

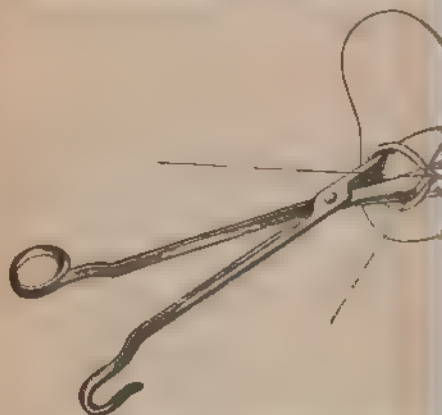


Fig. 448.—Direction of Forceps in Extraction of

stone. The forceps should be introduced along the blades, in the position for extraction. If its long axis be



Fig. 449.—Position of Finger and Scoop in Extracting Stone

in the event of fracture occurring, it will be necessary to irrigate freely and repeatedly with tepid water, injected through a tube introduced by the wound.

It is of the first importance to extract the stone, or even chipping fragments from it. No effort consistent with the safety of the patient should be made in obtaining this desirable result; not for the sake of the patient, but from a regard to the well-being of the bladder. If broken by the attempt at extraction, what is the result? obliged to introduce repeatedly the forceps to clear the bladder; the mucous membrane

ing the fragments, is liable to be pricked, bruised, and excoriated in the endeavour to seize them. The bladder requires to be frequently washed out with copious injections of tepid water, and the operation thus becomes greatly and dangerously prolonged. Even after much time and labour have been spent in these efforts, fragments are apt to be left behind which may occasion great present irritation, and, if retained, will form the nuclei of future recurrent calculi.

In children, and indeed in most cases in which the perineum is not very deep, so that after the introduction of the finger the stone can be felt and hooked forwards, the scoop is a most convenient instrument for its extraction; and in these cases I often employ it in preference to the forceps.

After the calculus has been removed, it must be examined for facets, or the interior of the bladder explored by means of a *searcher*, and, if other stones be found, they must be dealt with in the same way as the first.

The *gun-elastic tube* may then be introduced, and secured with tapes to a band round the patient's abdomen. This tube must be kept free from coagula, by the introduction into it, from time to time, of the feather of a pen. The tube is of great service by preventing the wound from becoming blocked up by coagula, and the free escape of the urine consequently interfered with. By means of this tube a ready outlet is given to the urine, the chance of infiltration is lessened, and if there be hemorrhage the wound may readily be plugged round it.

After-treatment.—The patient must then be removed to a bed, which should be properly arranged by having a large square of Macintosh cloth put across it. On this a folded sheet should be laid, which must be rolled up on the further side, so that, as it becomes wetted by the escape of urine, it may be drawn across from under the patient. This must be changed frequently, in order to keep him clean and dry. A full dose of tincture of opium in barley-water should then be given; a warm flannel laid across the abdomen; plenty of barley or gum-water allowed for drink, and nothing but rice milk or light pudding for diet during the first three or four days. After this some broth may be allowed, and the quality of the food gradually improved. Occasionally, however, it may be necessary to depart from this routine system of dieting the patient after lithotomy; and I have with great advantage allowed wine, and even brandy, a day or two after the operation. In an old man, on whom I some time ago operated at the Hospital, there was so great a tendency to depression, that it became necessary to administer the brandy-and egg mixture freely from the first; and to this, I believe, he owed his good recovery.

At the end of thirty-six or forty-eight hours the tube may be removed, the sides of the incision by that time having become glazed over, and little danger of infiltration existing. The urine continues to flow entirely through the wound for the first four or five days. About this time it frequently suddenly ceases to do so, escaping by the urethra. This is owing to the prostate becoming turgid by inflammatory action, and thus blocking up the aperture in it; but as this swelling goes down, in the course of a day or two, the urine usually escapes by the wound again, and continues to do so in gradually decreasing quantities until the aperture is finally closed, which usually happens at about the end of fourteen or eighteen days; though in patients who have suffered from phosphatic calculus it sometimes takes a longer period, owing to the broken state of the general health. Should the wound fall into a sloughy state, the patient must be put on a very generous diet, even a free allowance of stimulants; and the tincture of benzoin may

be daily applied. When slow of healing, of silver applied to the bottom; and, should may be touched with the electric cauter. constitutional treatment should be continued to prevent a recurrence of the disease.

LATERAL LITHOTOMY IN CHILDREN under the most successful of all the great operations, much in the same way as in the male; a few points of modification or of difference in young subjects. The following are worth remembering by the surgeon in proceeding to operate.

1. The urethra in children will communicate with the bladder perhaps at first be expected from their age and staff.

2. The perineum is usually proportionally smaller in consequence of the straining produced by the disease.

3. There is often from the same cause a protrusion of the rectum.

4. As the prostate is a rudimentary organ in children, necessarily passes, in most cases, beyond the neck of the bladder.

5. In children the tissues are more easily lacerable under the finger.

6. The most important point, however, is the position of the point of the knife in making the deep incision, and to be careful not to enter the recto-vesical space, which may happen under the hand of an inexperienced surgeon. I have known this to occur in several instances, and experience, the forceps being passed into the rectum, the position of its being the bladder; and in every case the finger is introduced. This accident is the more likely to happen, in children, as the tissues are very yielding, and readily admit of being pushed in; and the finger may thus pass between the bladder and the rectum, or into the loose cellular tissue of the rectum, and the bladder is opened, urine escapes; and the surgeon in the mean time, supposing the cavity, which he believes to be the interior of the bladder, so, but the recto-vesical space. The laceration of the bladder, a distressing and fatal accident is materially lessened by the use of tepid water, by which it is steadily kept open. In young children lithotomy is from this cause more dangerous. It falls to the lot of but few surgeons of the present day to pass through an active professional life without operating on children; and when it occurs, those will be the most charitable who have themselves had the most experience of the difficulties which it encounters.

DIFFICULTIES DURING LITHOTOMY.—There are two-fold; 1, in Entering the Bladder; 2, in the Extraction of the Calculus.

1. *Difficulty in Entering the Bladder*—This may, however, arise in consequence of the point of the knife well lodged in the groove of the urethra, and pushed into the recto-vesical space; the tissue

a kind of cavity that he mistakes for the interior of the bladder. If the perineum be very deep and the prostate enlarged, he may also experience some difficulty in reaching the bladder; but he can scarcely fail to do so if he push the knife well on in the groove of the staff, and dilate the incision in the prostate with a blunt gorget, if his finger fail to reach the cavity beyond it.

In children, however, great and sometimes insuperable difficulty has been experienced in opening the bladder. This difficulty arises in consequence of the small size of the urethra, the mobility of the bladder, and the ready lacerability of the tissues. If, after the groove in the staff has been exposed, care be not taken to insinuate, as it were, the nail into the opening in the urethra thus made, the membranous portion may be torn across; and the neck of the bladder, receding before the finger, may easily be pushed away from the surface, so that the surgeon may fail in reaching the cavity of the organ. When the road is once lost in this way, there is the very greatest difficulty in finding it again. The course that should be pursued is, I think, as follows. If the staff have not been withdrawn, the surgeon must again place the knife in its groove, and carefully push it on towards the neck of the bladder, notching that structure and passing the finger cautiously along the groove, and hooking down the parts with his nail until he reach the inside of the bladder. Should the staff have been withdrawn, the surgeon must endeavour to pass it again; if he succeed in this, he may act as just stated; but if he cannot succeed in introducing the staff fairly into the bladder, he must on no account whatever endeavour to open that viscus, or continue his attempts at the extraction of the calculus, but must at once abandon the operation until the parts have healed, when he can repeat it. The great danger in these cases arises from the surgeon losing his presence of mind, and endeavouring to enter the bladder without a guide—a procedure which must be unsuccessful, and can only end in the destruction of the patient.

In adults, the difficulty is to get out the stone; in children, to get into the bladder.

2. *Difficulty in Seizing and Extracting the Stone* is far more frequently met with than in reaching the bladder. This may be owing to a variety of causes. It is likely to happen in all those cases in which, either from the depth at which the bladder lies from the surface, or from the peculiar position of the calculus, the stone cannot be felt with the finger after the incisions have been made into the neck of the bladder.

Difficulty from the Position of the Stone.—The calculus may be lodged in the lower fundus. This is especially apt to happen if the patient be old and fat, and have a deep perineum, perhaps with enlarged prostate, behind which the stone may be lodged. This constitutes the greatest difficulty. Here the best plan is to use a much-curved pair of forceps, and to tilt the bladder up by introducing the finger into the rectum, so as to bring the stone within reach.

When the stone is situated in the upper fundus of the bladder, above the pubes, it is altogether out of the axis of the incision, and in such a case can only be extracted with great difficulty. Aston Key recommends that in such cases the abdomen should be compressed, and the calculus thus pushed down into reach. This suggestion is a very useful one; and it was only by employing this manoeuvre and using a very curved scoop, that I could remove a calculus lodged above the pubes, in the first patient whom I cut at the Hospital, many years ago.

Difficulty in consequence of the Stone being Fixed to or Retained in the

Bladder.—A small calculus may be encased in a membrane, and in this way elude the surgeon. In such circumstances, there is nothing for the surgeon to do but to disentangle and remove the calculus by means of a probe, if it can be so reached; if not, by expanding the bladder, and pushing aside the mucous membrane that surrounds it.

In consequence of *spasm of the bladder*, it has happened that a calculus has been so fixed, that, on application of the forceps, the blades closed between the walls of the viscus without touching the stone, and giving rise to the danger of rupture. I have been disposed to think that this "spasm of the bladder" is not so much a spasm, and that the real difficulty has arisen from a contracted and rickety pelvis. But, whatever the cause, the difficulty that has undoubtedly been encountered by the surgeon to desist from the operation, and for weeks endeavour to complete the extraction "*à deux temps*" of Deschamps.

The stone may be so fixed between the neck and the bladder, as to be detached with the forceps, the scoop will be found to be the best instrument for removal.

When the calculus is *encysted*, its extraction is attended with most dangerous consequences. In such cases, to operate is to operate in cases of encysted calculus the surgeon has been unfortunate. In such cases, containing an encysted calculus, he must be guided by the condition in which he finds the bladder. If the cyst be very small, as in Fig. 424, he must go no further with the operation, as it will not be worth the trouble. If, on the other hand, the cyst be large, he might feel disposed to make an effort to remove it. In such a view he might adopt the plan pursued by Deschamps, to endeavour to enlarge the orifice of the cyst by the bistoury cautiously applied, and then find the scoop. Such a proceeding, however, is in such cases, in account of the readiness with which the stone will escape the tonal cavity; as well as difficult in execution, as the parts are lying.

I believe that a calculus may occasionally be encapsuled, in another way,—by being enclosed in a membrane whilst lying on the floor of the bladder. In a child on whom I operated for stone some years ago, of about the size of a pea, I felt, with the finger, a body, covered apparently by mucous membrane, on the floor of the bladder. On scraping through the membrane with the point of my nail and a curved scoop, I extracted it, with a cyst attached to it. This cyst, which was of about the thickness of a pin, had a reddish colour, and resembling a piece of parchment. It was found to be a false membrane, composed of a single layer. The patient made a good recovery, without any of secondary hæmorrhage, which occurs after such an operation.

Rickets of the Pelvic Bones may constitute a serious or even an insuperable obstacle to the extraction of a calculus. This condition may act in two ways. It may narrow the brim of the pelvis in its antero-posterior diameter, to so great an extent as to prevent the passage of the stone downwards after it has been seized by the forceps. This condition is more to be feared in children, in whom the bladder, being an abdominal organ and lying high, is altogether above the brim of the pelvis in these cases. Or there may be difficulty in the extraction of the stone through the inferior outlet, owing to the approximation of the rami on each side. The first cause of difficulty once occurred to me, in operating on a very rickety boy four years and a half old. Of the second I have had no experience. The rickety condition of the pelvis may be suspected in cases in which the lower limbs are much distorted. Its existence may be ascertained by digital exploration of the rectum, and by external measurements. If it be found to exist to an extreme degree, it would probably be safer to perform the suprapubic operation.

Difficulty depending upon the Shape and Size of the Stone.—If the stone be very round, it is usually more difficult to seize than when flat or elongated. Flat, disc-shaped calculi, however, occasionally fall into the fundus of the bladder behind the prostate, and then cannot be readily reached by the forceps, which passes over them. Under these circumstances, they are best extracted by the curved scoop. Very flat broad calculi, and those that are round, egg-shaped, or branched, are the most difficult to remove, even though their size be not very great. As a general rule, however, it may be stated that, the larger the calculus, the more difficult is its extraction. This arises not so much from the outlet of the pelvis being too narrow, as from the necessity of making the internal incisions through the prostate to a very limited extent. There will always be considerable difficulty experienced in extracting calculi weighing six or eight ounces and upwards; though cases are recorded by Cheselden, Klein, and others, in which calculi from twelve to fifteen ounces in weight have been extracted by the lateral operation. Any calculus above one inch and a half in its shorter diameter will present considerable difficulties in being extracted through an incision in the prostate of the ordinary size; viz., not exceeding eight lines in length, even though this be considerably dilated by the pressure of the fingers; and I think it may be safely said, that a calculus two inches and upwards in diameter can scarcely be removed by the ordinary lateral operation with any degree of force which it is safe to employ. In the facility with which the calculus is extracted, however, much will depend upon the make of the forceps. As Liston most truly observes, "There can be no more fatal error than to attempt the extraction of a large stone with short and shabby forceps." In these cases I think the open-bladed forceps (Fig. 432) will be found useful, the absence of metal in the most convex part of the blade lessening materially the bulk of the instrument when grasping a stone.

In the event of the calculus being too large to be extracted by the ordinary lateral operation, what course should the surgeon pursue? Three are open to him: 1. Division of the Right Side of the Prostate from the interior of the wound; 2. Crushing the Calculus in the Bladder, and then removing it; and 3. The performance of the Recto-vesical Operation.

The Incision of the Right Side of the Prostate gives considerable additional space, and is sufficient for most ordinary purposes; very large calculi being fortunately very rarely met with. This section may be made in introducing into the wound a probe-pointed scalpel (Fig. 431), guided by the index-finger, and cautiously dividing the right side of the prostate downwards

and outwards, in the same way that the section of the left has been made. This procedure must be carefully done, with due regard to the important parts in the neighbourhood of the gland. In two cases I have seen Liston do this. In one the patient recovered, in the other he died of diffuse cellular inflammation of the pelvis; and I have had occasion to practise it once on a patient whom I cut at the Hospital, and who made an excellent recovery.

The second plan, that of *Crushing the Calculus in the Bladder through the wound in the perineum*, would certainly be a hazardous procedure. The

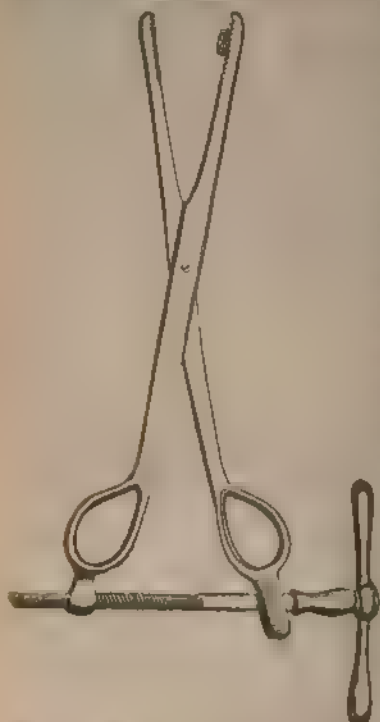


Fig. 450.—Lithotomy Crusher for Large Stone.

irritation that would necessarily be set up by the large incision, or crusher (Fig. 450) that has been devised for this purpose, by the presence of the fragments of stone, and by the necessary difficulty and delay of clearing them out of the wound, would probably be fatal to the patient. In the event of its being impossible to extract the calculus through the perineum, I think it would be safer to adopt the third course, and to perform the medical operation, which will presently be described. Should, however, the unusually large size of the stone have been recognised at the commencement of the operation, it might be thought more advisable to practise the high or the recto-vesical than the lateral operation.

Difficulty from Fracture of the Calculus.—The difficulty of extracting is greatly increased if the stone is broken. Fracture of a calculus is of two kinds. In the one case the stone is simply broken into small fragments, or splinters, so to speak, are detached from it. This accident may happen to hard as well as to soft calculi, and is generally owing to the surgeon employing too much pressure on the blades of the forceps, fearing that the stone may slip from between them; or it may arise from the large size of the calculus requiring some force to be exercised in its extraction, when the surgeon is very apt to compress the forceps as he draws the stone down. When this accident is found to have occurred, the surgeon must remove with care the fragments that have been detached. He should then wash out the bladder by copious injections of tepid water, and very carefully examine its interior for any loose pieces. It is seldom that any ill consequences result from this occurrence, except delay in the completion of the operation.

The second mode of fracture consists in the crumbling down of the calculus, so soon as it is seized by the forceps, into a soft mortary mass. The stone is not broken into large pieces, but, having naturally little cohesion, disintegrates into a mass of softish fragments, none of which pieces exceed a cherry-stone in size, and which indeed resemble a wet mortar.

aggregation, rather than distinct pieces of calculus. This crumbling down can only occur in phosphatic calculi, and is more likely to happen with the triple phosphate. It is in no way the fault of the surgeon, but arises from want of cohesion in the calculus, so that the blades of the forceps bite, as it were, through it. It is an unpleasant accident to occur, as it becomes extremely difficult, if not impossible, to clear away the whole of the soft mortary detritus from the interior of the bladder, to the lining membrane of which it tenaciously adheres, small masses lying under the folds into which the contracted organ is thrown. As much as possible should be removed by the scoop, and the remainder washed away, as far as practicable, by copious injections; with all care, however, some will be left behind, and may be discharged through the wound some days, or even two or three weeks, after the operation. When this happens, the bladder should be thoroughly washed out every day, or every second day, by warm water injections thrown in through a catheter passed down the urethra and allowed to regurgitate through the wound; and this plan must be persevered in so long as any foreign body escapes. Should the wound have healed, the detritus must be treated as in a case of lithotrity; and, by means of a large-eyed catheter, the bladder must be washed out every second or third day until all is removed.

ACCIDENTS DURING LITHOTOMY—The principal accidents that may occur during the performance of the lateral operation of lithotomy are Hemorrhage; Cutting the Bulb; Missing the Membranous Portion of the Urethra; Wound of the Rectum; or Wound of the Posterior Part of the Bladder.

Hemorrhage during lithotomy may occur from three sources:—1. The Superficial Arteries of the Perineum; 2. The Deep Arteries of this region; and, 3. The Prostatic and other Veins. When excessive, from whatever source it proceeds, it is always a very serious complication; for even if it do not prove fatal by the induction of syncope, &c., which I believe to be very rarely the case, it is apt to lead to a fatal termination indirectly, and at a later period, by favouring or predisposing to the occurrence of low inflammatory diseases, local or constitutional. I believe that patients who lose a large quantity of blood at the operation seldom recover.

1. Hemorrhage from the *Division of the Superficial or the Transverse Artery of the Perineum* is seldom of a very dangerous character, though occasionally, if these vessels be of larger size than usual, they may furnish a serious quantity of blood; in such circumstances their ligature would be required, and might be practised either before or after the extraction of the calculus. It is better, if possible, to wait until the completion of the operation, lest the ligature be pulled off during the extraction of the stone.

2. The *Division of the Deep Arteries* of the perineum, that of the bulb and the internal pudic, would be attended by far more serious, perhaps even by fatal consequences; as, from the depth at which the vessels are seated, it would almost be impossible to apply a ligature to them, unless the patient were very thin, and the perineum proportionately shallow. In the event of a ligature not being applicable, the surgeon would have to trust to plugging the wound around the tube, or to the pressure of an assistant's fingers continued for a considerable time. The pressure of the fingers of relays of assistants, kept up for a considerable length of time, is perhaps the surest mode of arresting the hemorrhage. The pressure must be kept up for many hours, thus South relates a case in which it was maintained for fourteen hours; and Brodie one in which, after twenty-four hours, it succeeded. The assistants should not be changed more frequently than necessary, each keeping up pressure for two or three hours, and removing his fingers as

cautiously as possible. It is, doubtless, very rare for these arteries to be wounded when they follow their usual course; though such accidents have happened in the hands of some of the most skilful lithotomists, such as Home, Bell, Roux, and Desault. It was the opinion of Aston Key that the artery of the bulb was generally cut during lithotomy; but in this I believe he was mistaken, so far as its trunk is concerned, though doubtless in many cases the bulb itself may be wounded, and the mesh of twigs, in which the vessel terminates, divided; this, however, would not yield an alarming hemorrhage. The trunk of the artery of the bulb would, however, be endangered by opening the urethra too high up, and lateralising the knife too early, and might bleed very freely.

The internal pudic artery, bound down by a strong fascia and under cover of the ramus of the ischium, runs but little risk unless the knife be lateralised too much, and the incision be carried too far outwards. It is in some of the anomalous distributions of these vessels that the greatest danger would be occasioned. The artery of the bulb, the inferior hemorrhoidal, the dorsal artery of the penis, or the internal pudic, may take such an anomalous course that their division must be inevitable; and, as the surgeon has no possible means of knowing beforehand whether the distribution of the arteries is regular or not, and as his incisions are all planned on the supposition that they are, he is not to blame in the event of a vessel being accidentally divided, when it takes an abnormal direction, with which it is impossible to be acquainted until after the accident has occurred.

If the incision be commenced too high up, and especially if the upper part of the first incision be made by pushing the knife in too deeply, the corpus cavernosum and its vessels may be wounded.

It may, I think, be stated as a general rule, that serious hemorrhage is usually best avoided by making the incisions low; and indeed, I believe that the great secret of success in the lateral operation of lithotomy consists in making all the deep incisions as low as practicable; the knife entering the groove of the staff from below upwards, rather than from above downwards.

3. *Venous Hemorrhage* may occur from two sources—the superficial or the prostatic veins. It is very seldom that any trouble arises from superficial veins; but in one case I have seen very considerable loss of blood occur from a large vein running transversely to and near the upper angle of the wound, lying almost immediately under the skin, which had been incompletely divided. From the prostatic plexus hemorrhage is most likely to occur in old people, in whom the veins in this situation are often enlarged—almost hemorrhoidal.

Whether the venous bleeding takes place from a superficial or a deep source, it is very apt to find its way back into the bladder, to mix with the urine, and thus to escape through the tube rather than from the wound itself; or the blood may probably coagulate in the interior of the bladder, distending that organ and producing a feeling of dysuria. Should it proceed from a superficial source, it may be necessary, as was done in the case just alluded to, to pass a ligature under the vessel, and thus arrest it. If it occur from the prostatic veins, the better plan will be to plug the wound. This is done by passing long strips of lint, either dry or soaked in a solution of perchloride of iron or of alum, along the tube, which must be left to the wound and kept pervious, or the lithotomy tube may have a "petticoat" of thick muslin tied round it, into which the strips of lint are stuffed. The advantage of this arrangement is, that the whole apparatus may very easily be removed together at the end of forty-eight hours.

Hæmorrhage from any of the above named sources, but more especially from the deep arteries and veins, may take place into the bladder; when this occurs, the urine that escapes will be seen to be deeply mixed with blood, and coagula will form in the interior of the viscus, which becomes distended and rises above the pubes, with dulness on percussion in the hypogastric region. The patient will become pale, faint, and cold. Under such circumstances, the coagula must be washed out of the bladder with cold water, the source of hæmorrhage ascertained by an examination of the wound, the further flow of blood arrested by plugging the ligature or the actual cautery, restoratives administered, the pelvis placed high, and the patient kept cool.

Wound of the Bulb is not of very uncommon occurrence in lithotomy; and I believe is of no consequence beyond furnishing a small additional quantity of blood. Indeed, the bulb is so situated, in many cases overlapping the membranous portion of the urethra, that this can scarcely be opened without wounding it.

Missing the Urethra altogether, and opening up the bladder through or even altogether beyond the prostate, is an accident that may happen if the surgeon miscalculate the depth of the perineum, and, keeping the incisions too low, thrust the knife too deeply. It is, I believe, an inevitably fatal accident, as in it the base of the bladder and the recto-vesical fascia are opened, and the patient is thus exposed to the occurrence of diffuse inflammation of, and infiltration into, the pelvic fascia. I was present many years ago at the *post mortem* examination of a fatal case of lithotomy, in which perhaps the most skilful operator of that day had opened the bladder beyond the prostate, leaving the urethra altogether untouched, and in which the patient had died from the cause just stated.

Wound of the Rectum occurs, I believe, more frequently than is generally supposed. It may happen either in consequence of the staff being too much depressed, the edge of the knife turned too directly downwards, or the rectum being distended and overlapping the sides of the prostate. I have also known the lower part of the rectum perforated by the surgeon's finger, whilst depressing the gut so as to keep it out of the way of the knife. The *Treatment* of this accident will vary according to the size and situation of the aperture. If it be of but moderate extent and low down, just above the anus, it will probably close as the wound granulates and the urine resumes its passage through the urethra. If the incision be more extensive and higher up, the patient will incur the risk of the miserable infirmity of recto-vesical fistula being induced. In such circumstances the proper treatment is to divide the sphincter and from the opening downwards, and thus to lay the gut and wound into one cavity, which will probably fill by granulation, and thus close the urinary passages.

Wound of the Posterior Part of the Bladder is, I believe, of very rare occurrence; yet it has happened in consequence of the knife being thrust too deeply along the groove of the staff, more particularly in operations on children, and would be specially apt to happen in such cases if the bladder did not contain much urine at the time. This is an additional reason for injecting the bladder before operating.

In *children*, the lateral operation of lithotomy presents certain special difficulties which have already been adverted to. These are; 1, the surgeon missing the bladder and opening up the recto-vesical space (p. 1088), 2, not opening the urethra and neck of the bladder sufficiently with the knife, but pushing these parts before the finger, and so tearing across the urethra, and thus necessarily being unable to complete the operation (p. 1089); and 3,

running the knife too far along the groove of the staff into the bladder, and thus wounding the posterior part of that organ.

SOURCES OF DANGER AND CAUSES OF DEATH AFTER LITHOTOMY.—Lithotomy, even in healthy subjects, is always a dangerous operation; and though the rate of mortality doubtless depends greatly upon the dexterity and skill of the operator, more is, I believe, due to the constitution and age of the patient, and especially to the state of his kidneys. Sir B. Brodie most justly says, "Success in lithotomy most undoubtedly depends in great degree on the manual skill of the surgeon, and on the mode in which the operation is performed; but it depends still more on the condition of the patient with respect to his general health, especially on the existence or non-existence of organic disease." That the mere cutting into the bladder is not a very dangerous proceeding, provided that viscus and the kidney be healthy, is evident from the fact that in those cases in which surgeons have had to extract bullets, bits of catheter, &c., from this organ, bad consequences have rarely occurred, though the operations have often been tedious. In lithotomy the case is different; for here the bladder is not usually in a state of chronic irritation, but the kidneys are frequently diseased, and these conditions influence the result of the operation materially than any other circumstances. Hence an operator may have run of unsuccessful cases; or by a fortunate concurrence of favourable causes more particularly in children, it has occasionally happened that a surgeon has cut 20 or 30 patients in succession without losing a single one, but several deaths then occurring, though the operation was performed in the same way and with the same care as before, his average had fallen to above the usual level. Green, at St. Thomas's, cut 40 patients in succession and only lost one. Lynn cut 25 patients for stone without losing one, and he said that he thought he had at last discovered the secret of performing lithotomy with success; but, he added, the Almighty punished him for his presumption, for he lost the next 4 cases that he cut. Brand Cooper, of Guy's, cut 30 patients in succession without a death, but he lost several, thus reducing the rate of mortality to the usual standard. Liston, during a period of six years, in which he operated 24 times, lost a patient from lithotomy at University College Hospital; but out of the whole 37 cases which he cut during the period of his connection with that institution, there were 5 deaths; reducing the average to 1 in 7.2. This success was, however, very great when it is taken into consideration that most of these cases occurred in adults, and that many of them were of a very serious character. I find on reference to the Hospital Records, that only 7 of the patients were under 10 years of age, whilst 14 were above 50; of these, 10 were 80 years of age, of whom one died and the other recovered. I believe that Liston lost only one patient under 60 years of age, and that was that of 18, in whom he found it necessary to divide the right side of the prostate as well as the left, and who died of infiltration of urine. Thirty-eight patients, successively operated on at the Norwich Infirmary, recovered, but the average rate of mortality in that Institution, calculated from 76 cases, has been 1 in 7½. Cheselden only lost 1 in every 10½, and, according to South, at St. Thomas's the mortality has not amounted to more than 1 in 9½; but a good many of these patients were probably children. Sir B. Brodie states, that of the 59 cases operated on in all the London Hospitals in the year 1854, 10 died; making the mortality as nearly as possible 1 in 6. But the more recent and extended statistics collected by Thompson, shows that the average mortality in the London Hospitals is 1 in 7½. According to Coulson the average mortality in England, during

from 1743 cases of the lateral operation, is 1 in 6·93 cases; whilst in France it is 1 in 5·7; and for Europe generally 1 in 5·14. The more recent statistics of Thompson show a more favourable result for lateral lithotomy in England. He finds that out of 1827 cases there were 220 deaths, or as nearly as possible 1 in 8.

Age exercises a more marked influence on the result of lithotomy than any other condition. Lithotomy may be looked upon as one of the most successful operations in surgery at early periods of life, a hazardous one in middle age, and an extremely dangerous one at advanced age. At the Norwich Hospital, lithotomy has been found to be four times as fatal in adults as in children. Coulson finds, on analysing 2972 cases of lithotomy, that the mortality at each successive decennial period is as follows. Below 10 years it is 1 in 13, and thence gradually augments from 10 to 80 years to 1 in 9, 1 in 6, 1 in 5, 1 in 4, 1 in 3·65, 1 in 3·23, 1 in 2·71.

The reason of the small mortality after lithotomy in children, as compared with adults, is twofold. In the first place, the urinary organs are less developed, and possess far less irritability than in the adult; and secondly and chiefly, the urine is less acrid, less irritating, less loaded with effete materials of an unhealthy character, and is consequently less apt to excite inflammation in those tissues over which it filtrates in its passage through the wound.

When children die after lithotomy, they do not usually perish from the same causes that prove fatal in the adult, viz. kidney-disease and diffuse pelvic inflammations and infiltrations; but they usually die in consequence of some accidental violence having been inflicted during the operation, such as the mistaking the recto-vesical space for the interior of the bladder, tearing across of the urethra and non-extraction of the stone, wounding of the recto-vesical fold of peritoneum, or perforation of the bladder by the point of the scalpel. It is by these accidents usually that death happens in children that are cut for stone, and not from circumstances that may follow the most skilfully performed operation.

The *Shock of the Operation* occasionally proves fatal, though probably much less frequently since the introduction of chloroform than was formerly the case. Yet, even now, patients occasionally die from this cause, induced either by a very much prolonged operation, or by the system being weakened, and having lost its resisting power in consequence of disease of the kidneys, perhaps of a latent character.

The *State of the Kidneys* influences the result of lithotomy in the adult more directly than any other condition. If these organs be sound, the patient will usually recover; hence in children, in whom the complication of renal disease rarely exists, lithotomy is very successful, even though the operation is proportionately far more severe in them than in adults. If, on the other hand, the kidneys be extensively and chronically diseased, the patient will commonly die, even though he have been operated upon with the utmost care and skill. The condition of the kidneys that is especially fatal is chronic pyelitis, and a granular state of the organs. This morbid condition is chiefly evidenced by the presence of albumen in considerable quantities in the urine, with muco-pus. If the albumen, in subsiding to the bottom of a test tube, after being coagulated by heat and acid, form a precipitate that does not amount to more than one-tenth of the bulk of the urine, the case may, I think, be looked upon as tolerably favourable; but, if it amount to one-sixth, the case is decidedly unfavourable, though even under these circumstances I have often seen recovery take place. Yet, with kidney-disease that will furnish such a quantity of albumen as this, the patient

will be very liable to the occurrence of low and diffuse cellular inflammation.

A *Prolonged Operation*, even under chloroform, is dangerous, and, although it is certainly not well to operate against time, yet it is undoubtedly advantageous to finish the operation with as little delay as is consistent with the safety of the patient, even though he be anesthetized.

Hemorrhage does not so often prove fatal, either shortly after the operation, or at a later period, as might be expected from the great vascularity of the parts incised. Secondary hemorrhage, of a dangerous or even fatal character, may, however, come on six, eight, or ten days after the operation. I have known it as late as the fourteenth day. It must be borne in mind that, when hemorrhage takes place after the operation, the blood may find its way into the bladder rather than escape externally, detained by the wound with coagula, but not giving any external evidence of the mischief that has occurred. Secondary hemorrhage will usually cease on plugging the wound with sponge or lint soaked in alum solutions. Should it prove serious, however, the actual cautery may be advantageously employed. In a case that occurred to me on the ninth day, the bleeding was stopped by wiping on the wound with the actual cautery, a practice which, I have been assured by Mr. A. Dalrymple, was occasionally successfully practised by that distinguished lithotomist, his father.

Cystitis is, in my experience, a rare sequence of lithotomy. I have, however, seen it occur, attended by the secretion of large quantities of ropy mucous from the bladder, coming away two or three days after the operation, with tenderness in the suprapubic region. It may arise before the operation, or occur either from long continued or rough manipulations with the forceps in searching for the stone, or from the irritation of the tube. The symptoms are apt to simulate those of pelvic peritonitis. The Treatment consists of leeches above the pubes, abundant demulents, and washing out the bladder with tepid water injected through the wound.

Diffuse Inflammation of the Cellular Tissue of the Pelvis, especially of the layers around the neck of the bladder, between it and the rectum, and that extend from thence under the peritoneum, is the most frequent cause of death after lithotomy. This inflammation, which is always of the erysipelatous kind, followed by rapid sloughing of the textures that it invades, may arise from two causes. 1. From the urine being introduced into the cellular tissue, in consequence of the incision extending beyond the limits of the prostate, into the loose layers of tissue that surround that gland; 2. In consequence of the bruising and laceration to which the neck of the bladder, the prostate, and the textures between it and the rectum, are subjected, in prolonged attempts to extract a large calculus from the bladder.

1. The danger of *Cutting beyond the Limits of the Prostate* in the actual has already been adverted to. In the extraction of calculi of ordinary size there can be no necessity to extend the internal incision, but when the calculus is of considerable magnitude, the surgeon, wishing to get as much space as possible, may inadvertently carry his knife beyond the prostate, or, if he make a cut into the right side of this gland, he may perhaps go a little too far, and thus open the loose cellular tissue or fascia which surrounds it, and which is continuous with the pelvic and subperitoneal space of cellular membrane. By dilating the incision in the prostate downwards and outwards, either with the finger or with a blunt gorget, the dense tissue surrounding the gland is not divided, and injury to this tissue is prevented.

If the incision extend beyond the prostate, the urine, as it escapes through

the wound, sinks into the meshes of the loose cellular tissue over which it flows, and thus gives rise to infiltration, followed by rapidly extending inflammation and sloughing, which speedily involve the whole of the neighbouring textures. This mischief generally occurs within the first forty-eight hours; indeed, I have never seen it come on after the third day. It is indicated by the patient being seized with rigors, followed by dry heat of skin, a quick pulse, which, after a time, may become intermittent, and a dry and brown tongue. At the same time he will complain of some tenderness about the lower part of the abdomen, and in the groins; the belly becomes tympanitic, the body covered with a profuse sweat; hiccup comes on, the pulse becomes more weak and fluttering, and death usually occurs about the fourth or fifth day after the operation. In some cases, there are more decided signs of peritoneal inflammation; but, as Brodie very truly remarks, this is not the primary disease, but is only induced secondarily by the inflammation and sloughing of the cellular tissue of the pelvis spreading to the contiguous serous membrane.

The *Treatment* of such cases must be conducted on the ordinary principles that guide us in the management of diffuse inflammations. It is only by administering ammonia, with such a quantity of wine or brandy as the state of the system may indicate, together with such nourishment as the patient can take, that life can be preserved. The disease is a depressing one, and requires a stimulating plan of treatment. Brodie has recommended that in these cases a free incision should be made through the sloughy tissues about the wound into the rectum, in accordance with the general principles that guide us in the management of similar affections elsewhere. In one case of the kind that occurred under his care, he saved the patient by passing a curved probe pointed bistoury into the wound to its furthest extremity, to the left side of the neck of the bladder; he then pushed it through the tunics of the rectum, and, drawing it downwards, divided the lower part of the gut together with the sphincter; thus laying the wound and the rectum into one. The relief was immediate, and the patient recovered. This plan of treatment certainly seems rational, and worthy of trial in similar cases.

2. Diffuse inflammation of the cellular tissue around the neck of the bladder and prostate arising from *Bruising and Over-distension* of the parts during the extraction of a large calculus is, I believe, a more frequent occurrence than infiltration of urine, and fully as fatal. This sequence of lithotomy is especially apt to occur in those cases in which, in consequence of diseased kidneys, or the existence of other organic mischief, the patient is more than usually liable to the supervention of diffuse or erysipelatous inflammation; indeed it is in this indirect way, I believe, that diseased kidneys constitute such a formidable obstacle to the safe performance of lithotomy.

In the extraction of large calculi, considerable traction is required, and force must be exerted; hence undue bruising and pressure are very apt to be inflicted upon the parts that constitute the line of incision. It is in this way that the danger of lithotomy increases almost in exact proportion to the size of the calculus: for here the surgeon is often placed between the horns of a dilemma. He must either cut beyond the limits of the prostate, and thus incur the risk of inducing urinary infiltration into, or diffuse inflammation of, the pelvic fasciæ: or else, by limiting his incision to the margin of the gland, and thus having, perhaps, an aperture of insufficient size, he may inflict severe injury by the bruising and laceration of parts during forcible and possibly prolonged efforts at extraction. It must, however, be borne in mind that, the larger the stone, the more probability is there of the existence of old standing disease of the bladder or kidneys, and of an unfavourable result

from this cause. Crosse, of Norwich, has drawn up a table that shows the influence of the weight, or in other words, of the size of a calculus on the results of lithotomy. He found that when the stone was one ounce and under in weight, the deaths were in the proportion of 1 in 11.25 cases. When it was from 1 to 2 ounces in weight, there was 1 death in 6.61 cases: when from 2 to 3 ounces, 1 death in 2.18 cases: when from 3 to 4 ounces, 1 death in 1.57 cases: when from 4 to 5 ounces, 1 death in 1.66 cases. The table, which has been constructed on the results of 703 cases, illustrates very clearly the fact, that the operation for the removal of a large calculus is more dangerous than that for the extraction of a small one.

The symptoms of diffuse inflammation of the cellular tissue arising from the cause now under discussion, very closely resemble those from infiltration of urine, and the treatment must be conducted on precisely similar principles.

Peritonitis does not frequently occur after lithotomy, except as a consequence of the extension of inflammation from the bladder or the pelvic fasciæ to the serous membrane, or from wound of the posterior part of the bladder. To one or other of these conditions, more especially inflammation of the pelvic fasciæ, it will always be found to be secondary.

Sloughing.—In persons of a feeble and cachectic habit, especially in the who are the subjects of phosphatic calculi, the wound will often assume a sloughy condition, and heal slowly. In such cases a liberal allowance of stimulants will be required, together with the local application of compound tincture of benzoin; and, in order to facilitate contraction at a more remote period, a solution of nitrate of silver, or the tincture of cantharides.

Having finished the consideration of the ordinary lateral operation, we shall now proceed to that of other methods for extracting the stone by cutting procedures. These are the *Median*, the *Bilateral*, the *Medio-lateral*, and the *Suprapubic* operations; each of which has its advocates, to the exclusion of the others, and each of which undoubtedly possesses certain special advantages. In addition to these, there are various modifications of these different operations which the ingenuity of surgeons has devised, but which are usually little to recommend them in the eyes of any except their originators.

MEDIAN LITHOTOMY.—The *median* operation of lithotomy is that procedure by which a stone is extracted through an incision in the raphe of the perineum, extending into the urethra behind the bulb.

History.—The history of the median operation affords an illustration of the mutability of professional opinion, and makes it appear as if there were a cycle of opinion in surgery, as in fashion, politics, and philosophy. The median operation was introduced three or four hundred years ago, and continued to be practised up to the middle of the last century, when, on account of its tediousness, its painful character, and the excessive mortality following, it caused it to fall into disuse as soon as the safer and simpler method of Celsus was introduced. Of late years, however, it has been revived under a somewhat modified form; and it is this modern median operation, and supposed advantages over the lateral, that we must here consider.

The old median operation—called also the "*Marian*," from one Sanson Marianus, who wrote on it, though it did not originate with him, and "*operation of the apparatus major*," from the number of instruments used in it—was performed in the following manner, according to John Hall: a grooved staff was introduced into the bladder, and the patient tied up in the usual way; the lithotomist then, kneeling or sitting before him, made an incision in the perineum, not exactly in the raphe, which was thought to be dangerous, but very slightly to the left side, and terminating just above the anus. The knife was then carried on to the membranous part of the urethra.

which was opened on the groove of the staff; and, the knife being kept firmly pressed against the staff, a long probe was introduced into the bladder by its side. The knife and the staff were now withdrawn, nothing but the probe being left in the bladder, to serve as a guide into this cavity. Along this probe, two iron rods, called "conductors," were now passed, and with these the operator dilated the prostate and neck of the bladder, by separating the handles—at least, it was said that he dilated them, but, as John Bell pathily observes, "he dilated, or, in plain language, tore open, the prostate gland." These conductors being held aside, "dilators" were introduced so as to enlarge the opening, the forceps were then pushed into the bladder, and the stone extracted as it best could.

The principles of this operation were—a limited incision in the membranous part of the urethra above the anus; dilatation, and not incision, of the prostate and neck of the bladder; or, to use the words of Le Cat, "small incision; much dilatation."

Its results were, however, so unsuccessful, that it fell into entire disuse here, and almost so on the continent, merely appearing from time to time under various modifications at one or other of the continental schools. This condition of things prevailed till ten years ago, when a new form of median operation was devised by Mr. Allarton, who with great perseverance and equal ability has urged it upon the attention of surgeons in this country, by whom it has now been extensively practised.

Operation.—This operation, for the introduction of which into modern surgery the greatest credit is due to Mr. Allarton, is performed as follows. A staff, grooved along its convexity, having been inserted into the bladder, the patient is tied up in the usual manner; the surgeon then, sitting in front, introduces his left index finger into the rectum, and feels for the apex of the prostate, against which he keeps it lodged, in order to judge of the distance of the prostate from the surface, to act as a guide to the knife, and prevent the rectum from being wounded. A straight-backed bistoury is now entered half an inch above the anal aperture, and pushed straight forwards to a depth of about an inch and a half in the mesial line, so as to enter, if possible, the groove of the staff at the apex of the prostate. A small incision upwards is then made in the groove of the staff, and, as the knife is withdrawn, the incision in the skin is also extended upwards; the knife is then laid aside, and a long ball-pointed probe is introduced into the bladder along the groove of the staff, which is then withdrawn. The probe is now the only guide to the bladder; and up to this point, therefore, there is but little, if any, difference between the modern median and the old Marian operations, except that the incision is exactly in, instead of a little to one side of, the middle line. The forefinger is now introduced along the probe, and by working it forwards the prostate is dilated, and the finger enters the bladder, when, the probe being removed, the forceps is introduced, and the stone extracted. Thus it will be seen that the only real point of difference between this and the old Marian operation, is that in the modern median the finger is used as the dilator, whilst in the Marian the prostate and neck of the bladder were forcibly expanded or torn open by the use of instruments; a difference, however, of no slight moment.

I have found it advantageous to modify this operation in one or two points. The first, which I think of some utility, is to use, instead of the ordinary curved staff, a rectangular one grooved from about one inch above the elbow nearly to the point, resembling the staff introduced by Dr. Buchanan of Glasgow (Fig. 451). Its use and advantages are that, when in the bladder, the angle rests against the apex of the prostate and can be felt in

the perineum, and the surgeon can judge of the exact point where to enter his knife (directing it so as to open the groove just below the angle), which he cannot do with the curved staff; the incision upwards also is limited, and the

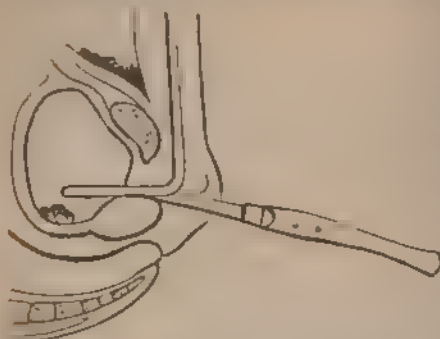


Fig. 451.—Median Operation with Rectangular Staff

is, besides, less dangerous, wounding the rectum, the urethra being drawn upwards away from it, and not pushed down against it, as with the ordinary staff. The knife should be straight, each having the blade not more than two inches long; so that the surgeon can tell to a depth he has entered it. I have found it advantageous in practice to carry a bone director, shaped like a hernia-director, along the groove, after the incision has been made in the urethra, so as to open up the canal and thus to clear the passage for the finger. After having opened the urethra, I think it is best to dilate the prostate before withdrawing the staff; by pushing the finger slowly, with a rotatory movement, along its side, the bladder is entered with more ease and certainty; whereas, if only the probe be used, it is not so stiff enough, and the surgeon is apt to push the bladder before him. It has been proposed to employ mechanical means of dilatation, instead of the finger, to open up the prostate and neck of the bladder, and I have seen some dilators for this purpose constructed by Mr. Coxeter on the principle of the two-bladed dilator of the female urethra. I have used them on a dead subject; but I have not ventured to use them on the living, lest, by the employment of screw-power, the same deep lacerations of the neck of the bladder should result that were so fatal in the old Marian operation. Indeed, I believe that their use would be fraught with danger from the liability to occasion rupture of the neck of the bladder; and if permitted I cannot but fear that they will bring discredit on the operation, reducing it to the condition of the old Marian, and repeating the dangers of that procedure. No safe dilatation can be effected except by the finger, with which no harm can be done, whilst it appears to me that the greatest possible mischief may be done with screw-dilators.

COMPARISON BETWEEN THE MEDIAN AND THE LATERAL OPERATIONS.—The two operations, the lateral and the median, cannot with propriety be compared as a whole, as we have as yet no sufficient statistics to enable us to determine whether the mortality after the median has been less than that which followed the lateral. We may, however, compare the modern median operation with the lateral, and endeavour to determine in what respects the median is superior, in what inferior, to the lateral, and in what cases it might be employed instead of the latter. For in this, as in lithotomy, the surgeon should not be too exclusive; it is his duty to learn and to practise different methods of attaining the same end, and to make use of one or other according to the requirements of the actual case before him, and to endeavour to select what is good and to reject what is doubtful in each method brought before him. It would be in the highest degree unwise to lithotomise only, or to cut only, every patient with stone coming under his care; and I believe that there is a choice as to the cutting operation in

or extensively torn and bruised to allow of the passage of a large stone. No amount of simple dilatation of which these tissues are susceptible can make a passage through them that will allow of the extraction of a stone $1\frac{1}{2}$ or 2 inches in diameter; such a stone must either be cut or torn out. Now what space have we in the median operation for the introduction of the forceps and the extraction of a large stone? Here, I think, is the weak point of the modern operation. In it the incision is made, and all the manipulation is practised, towards the apex of the narrow triangle formed by the rami of the pubic bones. The base of this triangle is represented by a horizontal line corresponding to the level of the membranous portion of the urethra, and consequently does not occupy the widest part of the perineum; it is formed by the transverse muscles of the perineum, and the lower portion of the deep fascia, supported and filled up by the rectum and the tissues which are attached to and support the gut on each side. These parts form a rigid wall or barrier stretching across the perineum, which cannot be depressed, and requires to be divided laterally into the ischio-rectal fossa before a stone of any considerable magnitude can be removed. It was in consequence of the extensive bruising and laceration of these structures, and the difficulty experienced in bringing the stone through them, that the old Marian operation fell into disuse.

In performing the median operation there are three points, or rather planes, of obstruction, between the surface and the interior of the bladder. The first is occasioned by the transverse muscles of the perineum, and, perhaps, also by the under portion of the deep perineal fascia. In the lateral operation we cut across this plane, and lay open the ischio-rectal fossa, giving abundance of room for the manipulation of the forceps and the extraction of the stone, along the base of the triangle formed by the rami of the ischiatic and pubic bones. But in the median we have to extract towards the summit of this space, at the apex of a narrow triangle, having the transverse muscles forming a tense bar along its base, and offering a material obstacle to the introduction of the forceps and the extraction of the stone.

The second obstacle lies in the prostate; but, as it is easily removable by dilatation, it cannot be considered a serious one.

The third, the deepest and most important, is situated at the neck of the bladder. We find here a narrow tense ring beyond the prostate; and this bar remains intact in spite of the dilatation and laceration to which the prostate has been subjected. On introducing the finger, we shall feel it grasped tightly by this ring. This inner ring of the neck of the bladder cannot be dilated beyond a certain point. I have found, by experiments on the dead subject, that it cannot be expanded to a size more than sufficient to extract a calculus of one inch in diameter without laceration or incision. The existence of this ring is the greatest barrier to the extraction of the stone, and its laceration or rupture is well known as one of the most dangerous and fatal accidents in lithotomy. It is in consequence of the obstacle offered by this that the median operation is not available for the extraction of large calculi. A calculus, for instance, two inches in diameter, cannot be extracted by the median operation without the employment of great violence. But though much force is usually required in order to extract a calculus of even moderate size through this tense ring at the neck of the bladder, it is an undeniable fact that serious consequences seldom follow the violence so used, and that a degree of force, which would be fatal in lateral lithotomy, may be employed without danger in the extraction of a calculus by the median operation. In this respect the extraction of a calculus

4. *Wound of the Rectum.*—This gut is not in much danger in the operation, unless it be distended. In the median, on the other hand, rectum is in considerable danger. If this operation be performed on a dead body, it will be found that the back of the bistoury comes very, I say uncomfortably, close to the finger in the rectum; and if another finger be placed in the wound, they will come into very close apposition anterior to the prostate. In the old Marian operation, the rectum was very frequently cut, air and feces issuing from the wound.

5. *Treatment of the Prostate.*—As to any difference in this respect—dilatation in the median, section in the lateral operation—I believe it is more imaginary than real. I think that it is very nearly the same in both operations when properly performed. All are agreed that in the lateral operation but a limited incision should be made in the prostate and near the bladder, these structures being merely notched, and the opening is then dilated with the finger, so as to avoid wounding the capsule of the prostate and opening up the pelvic fascia. The difference between an incision that opens the capsule of the prostate, and dilating this structure by the finger, is very great. The great object in lateral lithotomy is not to open up the pelvic fascia with the knife; and it is difficult, if not impossible, to tear this with the finger. If we take an aponeurosis out of the body, it will be found to be very difficult to tear; but if touched ever so lightly with the knife, it separates at once. So, in the median operation, the prostate is dilated to a considerable extent without opening its capsule. I have used the word "dilate;" but dilatation appears to me to be an erroneous term. I believe that the prostate is not simply dilated, but partially lacerated; that there is an actual laceration of the substance of the prostate, but not extending into or through its capsule. I have often examined the prostate in the dead subject, after it has been subjected to this process of "dilatation," and have always found its substance more or less torn. A laceration of the substance of the prostate, however, is of no consequence, and only becomes dangerous when it amounts to rupture of the capsule, when it exposes the patient to the fatal accident of extravasation of urine and diffuse inflammation of the pelvic fascia. Now, in the lateral operation, in running the bistoury down the groove of the staff, the surgeon may readily, unless care be taken, and very often, I believe, does actually and almost unavoidably go beyond the limits of the prostate, and thus exposes the patient to these dangers. In the median this cannot be done, if the knife be not withdrawn after the urethra is opened, the prostate being dilated solely with the finger. So far as this point, then, is concerned, I think that the median may be regarded as safer than the lateral operation, it being impossible to open up the pelvic fascia with the finger in the median, whilst they may be opened by the knife in the lateral.

In fact, the neck of the bladder and the prostatic portion of the urethra are in the median operation placed very much in the position of the female urethra when that is dilated for the extraction of a calculus: being dilated to a great extent, somewhat lacerated perhaps, but not torn through so as to admit urine into the fascia of the pelvis, and in that I believe the great essential superiority of the median over the lateral operation to consist.

6. *Manipulation of the Forceps and Extraction of the Stone.*—In the adult, the main difficulty of lithotomy does not lie in entering the bladder, but in the completion of the operation, that for which the operation has been undertaken—the removal of the stone. And the difficulty and danger increase in proportion to the size of the calculus; the distance between the neck of the bladder and the perineal integuments must either be widely

or extensively torn and bruised to allow of the passage of a large stone. No amount of simple dilatation of which these tissues are susceptible can make a passage through them that will allow of the extraction of a stone $1\frac{1}{2}$ or 2 inches in diameter; such a stone must either be cut or torn out. Now what space have we in the median operation for the introduction of the forceps and the extraction of a large stone? Here, I think, is the weak point of the modern operation. In it the incision is made, and all the manipulation is practised, towards the apex of the narrow triangle formed by the rami of the pubic bones. The base of this triangle is represented by a horizontal line corresponding to the level of the membranous portion of the urethra, and consequently does not occupy the widest part of the perineum; it is formed by the transverse muscles of the perineum, and the lower portion of the deep fascia, supported and filled up by the rectum and the tissues which are attached to and support the gut on each side. These parts form a rigid wall or barrier stretching across the perineum, which cannot be depressed, and requires to be divided laterally into the ischio-rectal fossa before a stone of any considerable magnitude can be removed. It was in consequence of the extensive bruising and laceration of these structures, and the difficulty experienced in bringing the stone through them, that the old Marian operation fell into disuse.

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by the median operation resembles the removal of one through the urethra of the female; the great point in favour of the median over lateral procedure, and the cause of comparative safety, being, that the fasciæ are not incised, nor otherwise opened. But, it may be said, is it easier, when the finger is in the bladder, than to push a probe-pointed toury along it, and cut downwards and outwards through these structures into the ischio-rectal fossa, if the stone be large, and thus get plenty of space? Nothing could be easier or more simple; but what would be the consequence? We at once reduce the median to the conditions of the lateral operation. A free incision in the neck of the bladder and prostate increases the tendency to hemorrhage, opens up the fascia, and exposes the patient, in fact, to all the dangers of an ill-contrived lateral operation, destroying once and altogether the principle of the median operation—viz., dilatation and not incision; and if we do not gain space by incision, but attempt to extract a moderately large stone by dilatation of the parts, we shall certainly not succeed, but our dilatation will end in a laceration, not only of the substance of the prostate, which is safe, but of the neck and perhaps the base of the bladder, which will be fatal. Urinary fistula was common in the old Marian operation. It remains to be seen whether it will be so in the modern median.

In conclusion, then, it appears to me that the median operation, when performed in suitable cases, has the advantages over the lateral of being attended by less risk of arterial hemorrhage, and with less danger of injury to the pelvic fasciæ: but, that in consequence of the very small size of the opening that can be made in the bladder by it, *provided these advantages be maintained*, it is only applicable to stones of at most a medium size, so that it cannot in all cases be substituted for lateral lithotomy, as the general operation for stone, where lithotripsy is not admissible.

Indications for the Median Operation.—The median operation may properly be performed in the following classes of cases. 1. In cases where foreign bodies, such as pieces of bougie, of tobacco-pipe, &c., are lodged in the bladder, the median is preferable, the body being small, elongated, and easily extracted. 2. It may be employed to remove stones not exceeding one inch in their smallest diameter. But then, it may be said, could stones of this size can generally be safely subjected to lithotripsy. That is true, in certain of these cases, lithotripsy is not admissible; so that the median operation is indicated in cases of small calculi in which lithotripsy cannot be practised in consequence of irritability of the bladder, or of the patient being too weak to bear repeated sittings. If a small calculus be lodged behind the prostate, in a pouch which occasionally forms at a lower part of the bladder, we may come down on it at once by the median method. 3. When there are numerous small calculi, lithotripsy is not desirable, and the median operation appears to be preferable. 4. In cases in which lithotripsy has been performed, and the patient is unable to expel the fragments, we may perform the median operation, and readily extract the detritus by a scoop, as it lies behind the prostate. 5. In the case also of calculi which are too large to be successfully subjected to lithotripsy, but which, if removed by the lateral operation, are attended by a frightful rate of mortality, it seems to me that the median operation might possibly be advantageously combined with lithotripsy. The stone having been broken up at one sitting, the fragments might at once be extracted through a limited incision in the median line of the perineum. 6. In cases in which the patient is so anxious to avoid the loss of an additional ounce or two of blood might turn the scale against him, median is preferable to lateral lithotomy. For, although it is by

means almost a bloodless operation, as is supposed by some, yet there is less hemorrhage during the performance, or rather, perhaps, less continuous oozing after its completion, than in the lateral, and there is certainly not the danger of the profuse bleeding that is sometimes seen in that operation. Where we have to do with a stone of large size, the median is not, in my opinion, safe; such an amount of traction must be used as will infallibly bruise and lacerate the neck and base of the bladder, and expose the patient to infiltration of urine and deep pelvic inflammation—to all the dangers, in fact, of the old Marian operation; dangers which were so great that more than half the patients subjected to it perished, and which caused it to be abandoned for the lateral.

I have said nothing special about the performance of the median operation in children. Under the age of puberty, lateral lithotomy is a very successful operation; certainly the most successful of all the *great* operations in surgery. The median can scarcely prove to be superior to it in this respect; and unless it can be shown to possess decided advantages over the lateral in ease of execution—and in this particular respect, in my opinion, it falls far short of the lateral—it does not appear to me to be desirable to abandon an operation of proved safety for one that is still on its trial.

BILATERAL LITHOTOMY.—The bilateral operation of Dupuytren is a modification of the median.

In it a transverse incision is made across the perineum half an inch above the anus, the horns of the incision extending to two-thirds of the distance between the anus and the tuber ischii on each side (Fig. 452). The dissection is carefully carried down to the central point of the perineum, and the membranous portion of



Fig. 452.—Lines of Incision in Bilateral Lithotomy (Dupuytren).

the urethra is opened on a grooved staff previously introduced; along this the double lithotome *caché* (Fig. 453) is passed, the blades expanded to a



Fig. 453.—Lithotome Caché

proper distance previously regulated, and both lateral lobes of the prostate divided to a corresponding extent downwards and outwards in withdrawing the instrument. The extraction of the stone is then effected in the usual way. This operation appears to me not to have received the attention from surgeons in this country that it deserves. By it the prostate is divided equally on both sides in its greatest diameter; if the expansion of the lithotome be carefully guarded, there is no danger of going beyond the limits of that organ or of wounding the internal pudic arteries; and the interior of the bladder is reached by the most direct and the readiest passage. In with-

drawing the lithotome, its concavity should be turned downwards and handle well depressed.

COMBINATION OF THE MEDIAN AND BILATERAL OPERATIONS.—Cruikshank recommended a combination of the median and the bilateral operations in lithotomy, by which the chief objections to both are got rid of. This mode of operation I have often practised on the dead subject, and once on a living, and it appears to me to be one well deserving a trial on the living for the extraction of very large calculi from the bladder; for those cases in fact, which cannot be removed by the ordinary median operation with too great an amount of force, and consequent bruising or laceration of parts. It is easy of execution, seems likely to be attended by little risk of hemorrhage, of urinary extravasation, or of pelvic inflammation, and of the bladder at the part which is nearest the perineal surface.

The operation may be performed in the following manner. The patient having been tied up, and a deeply grooved rectangular staff passed into the bladder, the urethra is opened at the membranous part with the edge of a knife turned upwards, as described in the median operation; the distal end of the lithotome is then slid along the staff into the bladder, its concavity turned downwards, the blades expanded to but a limited extent, and the prostate and the soft structures between it and the surface incised as it is withdrawn. If the stone be not very large, the incision may be confined to one side only, and made with a probe-pointed bistoury. It will be found that a great space is obtained by the perpendicular incision in the skin. The limited transverse cut removes that tension and resistance of the deep structures, which in the ordinary median operation interfere seriously with the manipulation of the forceps and the extraction of the stone, and, by division of both sides of the prostate to a limited extent, abundance of space is obtained.

HIGH OR SUPRAPUBIC OPERATION.—Although the median and lateral operations for lithotomy are perhaps the safest for the extraction of stones of moderate size, yet there can be no doubt that their results are extremely unfavourable, when the calculus exceeds a certain magnitude, and in these circumstances it may be deemed expedient to perform the "high operation" in preference to them. It is fortunate, however, that large calculi comparatively rarely met with, and will doubtless become more rare, as the diagnosis of stone can now be made at a very early period of the existence of the calculus, and as the treatment is now generally preventive. Of the 703 Norwich cases, that form the basis of Cruikshank's tables, indeed of our chief information on these points, 529 were under 1 ounce weight; 119 weighed from 1 to 2 ounces; 35 from 2 to 3, 11 from 3 to 4; 5 from 4 to 5; and only 4 were above this size. Hence, if we confine the high operation to those instances in which the calculus is above this size as will readily admit of extraction through the perineum, we shall not have occasion to perform it; yet instances occasionally occur in which the other method of extracting the calculus presents itself. Thus, by the method, M. Uytterhoeven succeeded in extracting a calculus, of which I have kindly given me a cast, which measured $16\frac{1}{2}$ inches in one circumference, and $12\frac{1}{2}$ in the other. It was perfectly moulded to the shape of the inside of the bladder, and clearly could not have been removed by any incisions through the perineum, as the outlet would have been insufficient for its extraction. The patient survived the operation 6 days.

But not only may the high operation be required on account of the size of the calculus; it may be rendered necessary by other conditions.

such as the existence of so much rigidity about the hips in consequence of rheumatic disease, as would prevent the proper exposure of the perineum; or by that region being the seat of disease which would interfere with any operation being practised through it; or the pelvic outlets may be so contracted by rickets as to prevent the possibility of the extraction of a stone through them by any of the perineal operations.

Operation.—The high operation consists in making an incision through the abdominal wall, above the pubes, and opening the anterior part of the bladder underneath the reflection of the peritoneum that passes upwards from its superior fundus.

In performing this operation, it is necessary that means should be taken to raise up the fundus of the bladder, so that it may project above the pubes, and thus admit of being safely opened. With this view various contrivances have been invented, such as catheters containing sliding stylets, which can be pushed through the bladder when that viscus is exposed. These instruments, though ingenious, are not necessary; for the end of an ordinary catheter introduced through the urethra, and made to project above the pubes, will serve as a sufficient guide.

The bladder having been slowly but fully injected with tepid water, so that it may rise above the pubes, an incision, about three inches in length, is to be carried from the pubes directly upwards in the mesial line. The pyramidales are then to be cut across near their origin, the linea alba exposed, cautiously opened near the pubes, and divided upwards some little way. The peritoneum must next be pushed back, and the dissection carefully carried through the cellular tissue above the bone, until the instrument previously introduced can be felt through the bladder, when, if it contain a sliding and pointed stylet, this may be pushed through the coats of the bladder; if not, an incision must be made down upon it, and the aperture in the organ enlarged downwards towards the neck of the bladder by means of a probe-pointed bistoury, so as to admit the fingers. The forceps must then be introduced, and the calculus extracted.

After the operation, there will always be risk of the occurrence of urinary infiltration into the cellular tissue around the margins of the wound. In order to prevent this, the older surgeons kept the bladder empty by making incisions through the perineum into the membranous portion of the urethra or neck of the bladder, thus complicating seriously the operation; but this accident may best be prevented by introducing a gum elastic catheter into the urethra, and leaving it there for a few days until consolidation has taken place and the wound shows a disposition to close, pressure being at the same time kept up on the lips of the incision.

Another cause of danger in this operation, is wounding the peritoneum, which may occur in consequence of the contracted state of the bladder causing it to lie low in the pelvis, and thus preventing the proper introduction of instruments to carry it up above the pubes.

Dr Humphry, of Cambridge, has collected 104 cases in which this operation has been performed; of these 31 proved fatal, chiefly from peritonitis and urinary infiltration—the mortality amounted consequently to 1 in $3\frac{1}{2}$; and M. Souberville, one of the greatest modern advocates of this operation, lost 1 patient in 3. The general result, therefore, is not very satisfactory; though, as in many instances the operation was performed in cases in which the internal method was not applicable on account of the size of the stone, we cannot with justice compare the two procedures in regard to the mortality attending them.

LITHOTRITY.

The operation of *Lithotrixy*, by which the stone is crushed in the bladder and the pulverised fragments are expelled or extracted through the urethra, is of modern, and indeed of very recent invention; for, notwithstanding that various rude and incomplete attempts may at different times have been made with this view, it was not until about the years 1818 or 1820 that the subject began to attract serious attention. About this time Civiale followed by Amussat, Leroy, and others, began constructing instruments which, though very imperfect, yet were sufficient to break down a calculus in the bladder. From this period the system made rapid progress; and successive improvements made by the surgeons whose names have just been mentioned, together with the ingenious mechanical adaptations introduced by Weiss, Heurteloup, Costello, and Charrière, enabled surgeons to attack the stone with certainty and effect. It is, perhaps, principally due to the labours of Civiale and Amussat in France, and of Brodie in this country, that the system has been brought to its present state of perfection. For the safe and proper performance of the operation of lithotrixy, the surgeon is not only to be acquainted with the general principles on which it is undertaken, but he must be thoroughly conversant with the more minute details in the construction and the manipulation of the instruments employed, as well as with the state of every part of the urinary organs. It is impossible for any surgeon who wishes to practise lithotrixy successfully, to devote too much time and attention to these points.

INSTRUMENTS.—The instruments required for lithotrixy are the following.

An ordinary *sound* with a short beak is required to examine the condition of the bladder. The steel sound should be hollow, so that the bladder may, if necessary, be injected through it after or during sounding, without necessity of changing the instrument (Fig. 428). This will be found of no service in the later stages of the operation for detecting small fragments.

A *brass syringe*, with rings, and having a large piston rod, so that it may work easily, should be at hand, and admit of adaptation to the hollow sound.

The surgeon should also be provided with *silver catheters* of three different kinds: one with large lateral eyes, another with a large eye in the convexity and a third with a large eye in the concavity near the point; all having elastic gum bougie fitted to the interior, instead of a stylet, to clear out the fragments. These should also fit to the syringe.

The instrument for breaking the stone consists of Weiss's *lithotrite*, represented in the annexed cut (Fig. 454); or a similar instrument with



Fig. 454.—Lithotrite for breaking the Stone.

by a rack and pinion is employed by some surgeons. The lithotrite should be made of well tempered steel; and should always be tested by being used to crush a piece of sandstone grit, of about the size of a walnut. It should be of as full a size as the urethra will readily admit; it must have the blades well serrated, and the female or under blade open at the beak, an oval aperture, through which the detritus of the crushed stone is forced, and thus any entanglement of it between the blades is prevented (Fig. 454).

The object of this open-bladed lithotrite is to break the larger and harder stones into fragments; but it is not equally efficient with the smaller calculi, nor can it pulverise the larger fragments.

The lithotrite should be cut out of a bar of solid steel, and not, as is the case with some instruments, made of a plate of this metal, turned up at the edges; as such a one possesses too little strength to be used with safety on large and hard calculi. Those cut out of a bar of metal have an external blade, having a grooved shape, as in Fig. 457. In this, the male or internal branch, cut to fit accurately (Fig. 456), slides smoothly, the whole instrument possessing an amount of strength and power that no calculus can resist. The bent-up instruments are composed of an outer tube of metal, as represented in its transverse section (Fig. 458), in which the internal blade fits less accurately (Fig. 455), but which possesses less strength, especially at the elbow, than those cut out of the solid. The scoop may, however, be so constructed without danger.



Fig. 456



Fig. 455



Fig. 458.



Fig. 457.

The lithotrite, such as is represented in Fig. 459, invented by Civiale, has a double action, enabling the surgeon to work it either by the hand or by a screw. In this instrument, there is no fenestrum in the female blade. It is of two kinds. In one, the male blade is much narrower than the female; in the other, it is nearly as broad. The first kind is useful in crushing through moderate-sized stones; the second kind, with the broad male blade, is used

in completely crushing up and removing the detritus of small calculi and the larger fragments into which a stone has been broken by the open-bladed lithotrite.



Fig. 459.—Civiale's Lithotrite for crushing Fragments.

in completely crushing up and removing the detritus of small calculi and the larger fragments into which a stone has been broken by the open-bladed lithotrite.

Besides these instruments, a small lithotrite is occasionally used for crushing fragments in the urethra; and another instrument, shaped like that represented in Fig. 142 (p. 372), for withdrawing them from that canal.

PREPARATION OF THE PATIENT.—Before proceeding to the operation of lithotripsy, it is necessary that the patient's constitution should be carefully attended to; the bowels should be freely opened, and the condition of the digestive organs attended to, and more especially that all local irritability about the urinary organs should be subdued by ordinary medical treatment. This is even of much greater importance in lithotripsy than in lithotomy. In lithotripsy, we must always expect that any existing irritation or inflammation of the bladder will be increased by the necessary introduction of instruments, and by the presence of sharp fragments of calculus in the bladder, and their passage along the urethra; but in lithotomy all source of irritation is at once removed by the extraction of the stone. The condition of the urinary organs must be very carefully examined; and, if these be diseased, it will probably be requisite to abandon the operation.

In a subsequent part of this chapter, when we come to the comparative lithotomy and lithotripsy, we shall examine the conditions which render each more or less favorable to the performance of the latter operation. At present we will suppose a case in which the surgeon may have recourse to lithotripsy with every prospect of readily and permanently freeing the patient of his calculus; one in which the calculus is of moderate size, soft, and not too hard; the urinary organs healthy, and not over-irritable, and the patient an adult, but not too aged. In performing the operation in such a case, but little preparatory treatment is required; though it is well to keep the patient quiet for a few days, and to regulate the bowels before anything is done. Should the patient's health not be in a satisfactory state, or should his urinary organs be irritable, he must be treated on ordinary medical principles until his health be restored, and then restored for the surgeon safely to undertake an operation. Should the patient be nervous about the use of instruments, or should the bladder be irritable, a large sound may be passed every second day, so as to accustom the patient and the parts to the use and contact of instruments.

USE OF ANÆSTHETICS.—Much difference of opinion exists as to the advisability of employing chloroform in lithotripsy. It has been objected to its use that the sensations of the patient are an useful guide to the surgeon in his manipulations; and that, if these be annihilated by anæsthetics, error may be done by the lithotrite nipping or otherwise bruising the mucous membrane. But this objection is not tenable. It is the sensations of the surgeon, and not those of the patient, that constitute a valuable guide, although in the majority of cases lithotripsy, when properly performed, is almost a painless procedure. Yet cases not unfrequently occur in which the patient can with difficulty support the necessary manipulations, and which either from nervousness or from irritability of the bladder, he rejects the introduction of the lithotrite, or even does not allow his bladder to be duly distended by injection. In such cases chloroform is of inestimable service; and many patients when anæsthetised can be safely supported in lithotripsy, who could not suffer the operation under other circumstances.

OPERATION.—The operation of lithotripsy may be divided into three stages.

1. The Introduction of the Instrument. 2. The Search for and Seizure of the Stone. 3. The Crushing of the Stone.

1. *Introduction of the Lithotrite.*—Lithotripsy may most conveniently be performed with the patient either lying on his back upon a hard mattress, or on a couch or table. If the patient be very stout, or the prostate enlarged, the pelvis may be raised by a hard pillow, so as to allow the stone to rest on the posterior surface of the bladder. The surgeon, standing on the right side of the patient, carefully introduces the hollow sound, or catheter, and draws off the urine; he then slowly, and very cautiously, injects the bladder, by means of the brass syringe, with from four to six ounces of tepid water. The use of drawing off the urine is to make sure of the bladder holding the proper quantity of fluid when it is afterwards injected; and the object in injecting it, is to distend it with fluid to such an extent as to prevent the mucous membrane from being seized in the grasp of the lithotrite, or injured by the splintering of the stone. The instrument is then withdrawn, after the situation of the stone has been detected by it, and the lithotrite is introduced. Should the patient be able to hold enough urine to protect his bladder from the action of the lithotrite or the fragments, the injection may be dispensed with, and the lithotrite may at once be used. As this is straight, with a sharp elbow near the beak, some little skill is required in passing it. In doing this, the surgeon must keep his eye upon the direction

curved beak of the instrument, the direction and position of which must be constantly observed or rather judged of; and especial care must be taken, in carrying it under the pubes, not to injure the urethra by pushing the beak of the lithotrite forwards too suddenly, instead of wounding it, as it were, under the arch of that bone. The instrument should first be introduced nearly parallel to the abdomen, the penis being held between the left fore and middle fingers, and drawn over it. As the lithotrite passes down, it must be gradually raised to the perpendicular position; and as its curve passes under the pubes, the handle should be depressed between the thighs (Fig. 460). The direction of the curve is the thing to bear in mind; and the position of the handle must be varied in accordance with the course which this takes. The lithotrite should be well greased with olive oil, so that the branch and screw may work smoothly. Lard or ointment should not be used for this purpose, as it is apt to clog, and to entangle gritty bits of calculus.

2. *Seizure of the Stone.* — The next point is to seize the stone, which will generally be found in the situation where its presence was detected during the sounding of the bladder. If large, the stone will probably lie low, near the neck



Fig. 460.—Introduction of the Lithotrite.

of the bladder; if small, it is most frequently met with at the right side, or at the inferior fundus. Should it be situated in a sacculus or depression in this region, it may most readily be seized by introducing a finger into the rectum, and raising up the lower part of the bladder; or, better still, by raising the pelvis on a hard pillow, and so causing the stone to roll up on the posterior surface. Sir B. Brodie strongly advises that the lithotrite should never be used as a sound to ascertain the position of the stone; if this be done, the patient suffers pain, the bladder is irritated, the urine is expelled, and the stone not readily seized. In seizing the calculus, a good deal of tact is required. There are two ways of seizing the stone. Sir B. Brodie recommends that it should be done by pushing the female blade of the lithotrite against the inferior fundus of the bladder, pressing gently down with it so as to make a conical depression in this situation, and then inclining the beak towards the stone, drawing back the male blade with the thumb (Fig. 461); with a slight shake or jerk, the surgeon then tries to get the calculus between the blades, at the same time that the male branch is being pushed forwards to seize it. In this manœuvre the female blade should be moved as little as possible, but the stone must be seized by pressing the thumb upon the half circle of steel fixed on the male branch. In this way the stone may often be seized at the first attempt, but in other cases it is not grasped until after several efforts have been made to fix it; the calculus, especially if round, slipping away from between the blades of the instrument, and being merely scraped by them. Civiale adopts another procedure. In passing the lithotrite, he feels where the stone lies; he then very gently turns the beak of the instrument towards the opposite side of the bladder, opens the blades, and then, turning them over towards the stone, seizes it between the open blades. In these

manœuvres, all rough handling must be most carefully avoided, and the instrument should be turned about as little as possible. It is far safer to

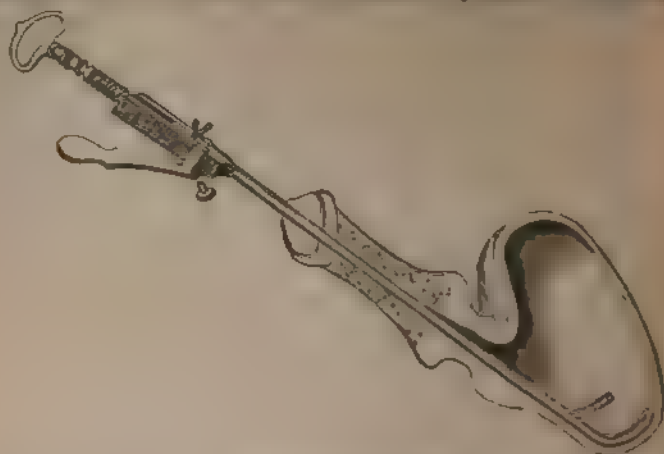


Fig. 461—Seizure of the Stone.

desist in the operation, if there be any difficulty in seizing the stone, than to persevere in repeated and fruitless attempts, by which the bladder may be severely injured and inflamed. Rather than do this, the patient should be allowed to get up and move about for a few minutes, when the position of the stone may be so far altered that it admits of being seized.

3. *Breaking the Stone.*—When the stone has been seized, it is gently raised in the grasp of the lithotrite, so as to be placed about the middle of the bladder, and it is then crushed. This important step of the operation, like all the others, requires to be deliberately and carefully done (Fig. 462).



Fig. 462.—Position of Lithotrite in crushing the Stone.

If Civiale's improved lithotrite be used, the stone, if small, may often readily be crushed by the pressure of the hand alone without the action of the screw (Fig. 463). If the ordinary lithotrite be employed, the breaking



Fig. 463—Position of Hand in using Civiale's Lithotrite.

should not be effected by suddenly and forcibly screwing up the instrument, but the screw should be gradually worked by a series of short and sharp

turns, so as to constitute almost percussive movements (Fig 464). In this way the calculus is generally made to crumble down, rather than to fly



Fig 464 —Position of Hands in using ordinary Lithotrite.

asunder; and, as it yields, the screw must be worked tightly home. The blades of the instrument may then be opened again, a fragment of the broken calculus seized and crushed in the same way as before; and thus the disintegration of the stone is in a great measure effected and sometimes completed at one sitting. It is of the greatest moment, however, that too much time be not consumed at one sitting. Nothing is more dangerous than the long-continued contact of instruments with the interior of the bladder; in this way great irritability, or an atonic condition of this organ, terminating in low cystitis and pyæmia, is apt to be produced, and death may thus result. The shorter the sittings, the more likely will the case do well. The first sitting should not exceed ten minutes, and the subsequent ones five. In the repetition of the sittings, the surgeon must be guided by the effect produced on the stone and on the bladder. The calculus may be entirely destroyed in one sitting, but most commonly from three to five or six are required, these should, if possible, be conducted at intervals of three or four days, though this must depend upon the amount of irritation induced by them.

At the first sitting, it is sufficient to break up the stone; the fragments being left to be dealt with subsequently. This sitting is by far the most important of all: it should not occupy more than about five minutes. After the stone has been broken up, the patient should be made to lie on his back for about twenty-four hours, be kept warm, and be plentifully supplied with diluents. He should pass water in a urinal, and not be allowed to stand up or to lean forward, lest the fragments fall against or become fixed on the neck of the bladder, where they may produce great irritation and distress. Much of the success of lithotripsy will depend upon the gentleness with which the proceedings are conducted during the first sitting, and the care with which the patient is managed for a day or two subsequently.

Before withdrawing the lithotrite, the surgeon must be careful to see, by the scale on the handle, that the male blade is well home. If this be not the case, and the instrument be enlarged by any fragments or detritus being entangled between the blades, laceration of the neck of the bladder or urethra might occur in attempting to withdraw it.

After the stone has been broken, little detritus will usually escape during the first twenty-four hours; but after this it is expelled, in some cases in considerable quantity, each time the urine is passed. In others, it does not escape so readily; and then the surgeon requires to introduce Civiale's instrument (Fig. 459), by which he can seize the smaller fragments, crush them, and, screwing the instrument home, extract the beak filled with detritus. In using this instrument, however, care must be taken not to get hold of too large a fragment; for, in breaking this up, whether by the hand or screw, the beak may be clogged with the detritus in such a way that

it does not readily close, and then there might be considerable difficulty in withdrawing it. Should this accident occur, the scissor may be engaged, passing its beak back into the bladder, tapping sharply upon the instrument, and moving the male branch to and fro. In crushing fragments between the prostate, Civiale turns the concave part of the beak downwards, and withdraws the fragment in this position. In doing this, however, great care must be taken not to nip the mucous membrane of the bladder.

After each sitting, except the first, the bladder may be washed out by injecting it with tepid water through a catheter. The most convenient



Fig. 405. Large Silver Catheter for emptying Bladder.

instrument I have employed for this purpose is a full-sized silver catheter, nearly straight, and having a large eye in its concavity (Fig. 405). This acts as a scoop, and will bring away large quantities of fragments that can not readily escape through the catheter with internal eyes, or that has an opening at its convexity. For bringing away the finer detritus, a double current syringe is useful. In using the latter instrument, the point of which should be directed towards the inferior fundus, a considerable quantity of water may sometimes with advantage be pumped through the bladder by adapting a flute-valve syringe or elastic bottle to it.

The interval between the sittings will vary according to the effect produced. If all go well, the second sitting may usually take place about five or six days after the first, and they may then be repeated at intervals of from three to four days; each sitting should be short—not exceeding five to eight minutes. When the surgeon believes that the bladder has been emptied of all fragments and detritus, a final exploration must be made. This last act of the operation is necessarily one of the greatest importance, as on the precision with which it is conducted depends in a great degree the future immunity of the patient from a recurrence of the disease. Any fragment, however minute, that is left behind necessarily constitutes the nucleus of a further calculus.

The exploration is best conducted by means of a small lithotrite, the bladder containing but a moderate quantity of urine. The whole of the interior, but especially the part behind the prostate, should be carefully explored; and if any fragment be found it must be crushed, and the detritus extracted. Civiale employs the "trilobe," allowing the urine slowly to trickle out through the shaft of the instrument, at the time when he is drawing and closing the blades over the floor of the bladder, by withdrawing the tubular shank over them. As a measure of additional safety, the exploration should be repeated after the lapse of a week or two, and the bladder be well washed out after each procedure.

During the whole of the treatment, it is necessary to adopt means to allay irritation. With this view the patient should be kept in bed, or on a couch, a moderate diet only should be allowed, plenty of demulcent drinks given, such as barley water, soda-water, or milk; and opiates or benizans, if necessary, should be administered.

The amount of irritation of the bladder developed after lithotomy will vary greatly in different cases. In some, where the stone, when introduced, has excited much pain and irritability of the organ, the sufferings are at once lessened by its being broken up. It is difficult to account for this, except on the supposition that the fragments, being spread over a wider surface than the unbroken calculus, press less directly on any one part, and produce less local irritation. More frequently, however, the crushed stone

produces much greater irritation than the unbroken one. In this respect, however, much will depend upon the care that is taken after the operation. If the patient be kept lying on his back, if diluents be freely given, and opiate and belladonna rectal injections used, the irritation from this source will be materially lessened. But if the patient be allowed to walk about, and to pass urine standing up or leaning forward, some of the fragments may be driven into the neck of the bladder, or even the deeper part of the urethra, producing there the most intense and painful strangury. When this unfortunate accident occurs, the patient will pass urine every half hour or oftener, squeezing out a few drops, writhing, and perhaps screaming with the agony he suffers, as the vesical neck contracts on the ragged fragments; his pulse will become quick, his skin hot and perspiring, his tongue dry, the urine scanty, high-coloured, and perhaps more irritating; and, unless relief be speedily given, nervous exhaustion will set in, and death ensue. Under such unfavourable circumstances no time is to be lost. The patient should be anaesthetised, the bladder injected with weak belladonna solution, gr. i. to ℥iv. of water, the lithotripsy scoop introduced, the fragments broken up as completely as possible, and detritus taken away, or washed out. No other means than this, or lithotomy, will save the patient; and nothing is more remarkable than to witness the immense relief that the patient derives when the large angular fragments are broken up into detritus.

ACCIDENTS IN LITHOTRITY. —In considering the accidents in lithotripsy, I put out of consideration those that may arise from the surgeon acting carelessly, or with improper force, and thus occasioning laceration of the urethra, or injury to the coats of the bladder; so also accidents occurring from the bending or breaking of the instruments will scarcely happen, if these have been properly tested on a piece of sandstone grit before being employed in the bladder.

Impaction of Angular Fragments of Stone in the Urethra.—This is a most dangerous and painful accident, and not only occasions great local irritation, ending perhaps in cystitis or abscess, but may give rise to severe rigors and nervous prostration. It most commonly arises either from the surgeon attempting to do too much at the first sitting, or from the patient moving about too much, or straining to pass urine after the stone has been broken. The fragments are especially apt to lodge in the prostatic urethra, or about the bulb, and there give rise to a very great degree of irritation, and even of fatal mischief, producing great constitutional disturbance of an irritative and asthenic type. When the pieces are impacted low down in the urethra, it is absolutely necessary to remove them from the canal as speedily as possible, lest the constitutional disturbance occasioned by them prove fatal to the patient. This may be done in various ways. Most frequently, they may be pushed back into the bladder by passing a large catheter carefully down to them. The most convenient instrument for this purpose is one that is open ended, so that the fragment may be received in the aperture at the end of the instrument, and so pushed on before it. Through such a catheter as this a stream of water may be injected, and the fragment



Fig 466 — Urethral Lithotrite

thus forced back. Should these manœuvres fail, it has been proposed to crush them in the urethra with a small lithotrite (Fig. 466), but this plan

is somewhat hazardous, as it is very difficult to avoid puncturing up the mucous membrane of the canal with the bit of stone. The safest procedure seems to be, either to extract them through the urethral orifice, or to cut them out through the perineum. Extraction through the urethra can only be effected by the forceps (Fig. 467), or by Civiale's instrument (Fig. 111).



Fig. 467.—Urethral Forceps

Should this means fail, or should the fragment be very deeply seated, as in the membranous portion of the urethra, and the local and constitutional irritation produced by it be so great as to threaten abscess or a fatal termination, the better plan would be to make an incision directly over upon it, and to remove it through the perineum by a medial operation of lithotomy. If such an operation as this be required, the surgeon might possibly feel disposed to extend the incision a little, and empty the bladder of any remaining detritus by means of a scoop.

The *Chronic Enlargement of the Prostate* of old people complicates seriously the operation of lithotomy, not only in rendering the introduction of instruments more difficult, but in offering an obstacle to the escape of the fragments. Enlarged prostate cannot, however, be considered to be in any means an insuperable bar to lithotomy; as, after the stone has been crushed, the bladder may be emptied by means of the scoop, or by Sir F. Crampton's device, which consists in exhausting the air from a properly constructed bottle, fitted with a stop-cock, and then attaching this to a catheter previously introduced, and opening the stop-cock, when the pressure of the atmosphere drives the contents of the bladder, urine and all, into the exhausted bottle. As a general rule, it is not desirable to turn the blades of the lithotrite downwards, lest the floor of the bladder be injured. But in some cases in which a small stone is lodged, or fragments have fallen into a pouch behind the prostate, or in which the prostate is enlarged as to form a bar which rises above the floor of the bladder, it will be impossible to seize the calculus or the fragment, unless this manoeuvre be adopted. In doing this, risk of injury will be materially lessened, if not altogether removed, by somewhat depressing the handle of the lithotrite, and thus preventing all downward pressure of the blades, which are gently opened and closed over the base of the bladder.

DANGERS IN LITHOTRITY.—The principal dangers in lithotomy arise from the state of the bladder and kidney. They consist in the induction of Cystitis of a low form, Atony of the Bladder, or Renal Irritation, or in the occurrence of Pyæmia, with much constitutional disturbance of a low type.

Cystitis may occur in consequence of the increased irritation to which the bladder is subjected. It sometimes occurs during the earlier period of the operation, in consequence of the irritation of the bladder by large and angular fragments, and subsides at once when these are crushed up and pulverised. Should it continue, it speedily assumes a low form, and is apt to prove fatal by the induction of typhoid symptoms, even if it does not do so, its continuance is an insuperable obstacle to the further crushing of the

stone; and in cases of this kind the best course that could be pursued will be, after getting the patient into as favourable a state as possible, to remove the fragments by lithotomy.

Atony of the Bladder is one of the most dangerous conditions that can occur in lithotomy. This state of things happens usually in old people, in whom the urinary organs may appear to be in a peculiarly quiet and favourable condition before the operation, the patient being able to hold his urine for six or eight hours, and to bear the injection of ten or twelve ounces of fluid. Under these circumstances, the surgeon should be upon his guard; for the danger of this condition is, that the bladder does not possess sufficient contractile power to expel the fragments. These consequently accumulate in the lower fundus, and irritate the mucous membrane, and thus the foundation may be laid for fatal cystitis, which in these cases always assumes a typhoid type.

The atony of the bladder appears to arise partly from that natural want of expulsive power, which is not unfrequent in old people, and partly from a kind of paralysis of the organ, induced by the contact of the instruments, especially after long sittings, and by the pressure of the fragments, by which the bladder is, as it were, overpowered. Such patients usually die with severe constitutional depression, and with pyemic symptoms.

When atony of the bladder has come on, it is essential that the surgeon should rid the patient of the fragments which he is unable to expel. This may sometimes be done by means of the scoop, assisted by washing out the bladder through the large-eyed catheter; but the safer plan would probably be, to get the patient into as good a condition as possible, and then cut him. Thus I once did in an interesting case under my care at the Hospital; the patient, an old man, had been lithotomised by a surgeon out of doors a few weeks before admission, but no fragments had passed; on sounding him, I found a moderate-sized calculus, with what appeared to be a large mass of soft concretion, of the nature of which I was not aware until after its removal, the patient having concealed the fact of his having been lithotomised. On cutting him in the usual way, I removed a lithic acid calculus about as large as a pigeon's egg, and a handful of fragments of another calculus of the same composition, which had been crusted over and matted together by phosphatic deposit. The patient made a very good recovery. In such cases I should, in future, perform the median operation, and clear out the bladder with a scoop.

Irritation of the Kidneys, giving rise to suppression of urine, occasionally occurs. In such cases, cupping the loins, and the warm hip-bath, would be the proper treatment to pursue.

Constitutional Disturbance.—Very considerable constitutional disturbance occasionally follows lithotomy. The patient is seized with severe and long-continued rigors, followed by profuse sweating, lasting for many hours. These serious symptoms are most apt to come on after the first sitting, and are analogous to those nervous phenomena that are apt to follow upon the introduction of instruments in strictures, &c. They may pass off, leaving merely a temporary debility; or a typhoid state may set in; the pulse becoming quick, feeble, and intermitting, the skin hot and dry, and the tongue brown. This condition is apt to prove fatal, either directly, or by intercurrent visceral mischief: it appears to arise in many cases from causes independent of the operation, or that are called into activity by the shock and slight constitutional disturbance induced by it. This is more especially apt to happen when there is latent disease of the kidneys. Indeed, there is no condition of system that is more directly antagonistic to the success of

lithotripsy than chronic diseases of the kidneys, as indicated by the presence of much albumen in the urine. When this occurs to any considerable extent with or without casts of tubes and blood, the increased irritation induced by the operation will almost to a certainty prove fatal. In other instances again, the fatal result is more directly dependent on the irritation induced by the operation leading to the formation of abscess in the neighbourhood of the prostate, or around the neck of the bladder; and in other instances again, on the supervention of unhealthy suppuration in some of the abscesses that are occasionally met with in this organ. From whatever cause arising this condition is usually eventually fatal by the supervention of pyæmia, and is undoubtedly often predisposed to by the previous existence of chronic renal disease.

The *Treatment* of this state of things should consist in the free administration of stimulants—brandy, ammonia and ether followed by full dose of opiate, and abundant warm diluents. Especial care must be taken not to repeat the sitting for at least a week or ten days after rigors have passed off.

COMPARISON BETWEEN LITHOTOMY AND LITHOTRIPSY

Lithotomy and lithotripsy differ so entirely from one another in principle and detail, that it is useless to attempt to establish a comparison between different steps of these two operations. It is, however, a question of very first importance and interest to ascertain by which operation a patient can most safely have a calculus removed from his bladder. In determining this point, it is not only necessary to make a comparison between the general results of cases that have been subjected to the two procedures, but especially to ascertain those circumstances that influence the result of an operation in particular cases—to determine, in fact, in what cases lithotomy and in what lithotripsy, holds out the best prospect to the patient. It is, I think, in the highest degree impractical to enter into a discussion as to which should be the general method of treatment in cases of stone. Both operations have been reduced to great simplicity and certainty; but neither should be exclusively practised. It is undoubtedly the duty of the surgeon to make himself familiar with the practice of both, and to adopt that which promises best in the particular instance with which he has to do. However, I were called upon to say which operation I consider most generally applicable, then I should unquestionably answer lithotomy. Yet there can be no doubt that there are many cases in which lithotripsy is the preferred method; and in those in which lithotomy or lithotripsy may be done with equal chance of success, the preference should be given to the crushing or the cutting operation.

STATISTICS.—The statistics that are before the profession do not represent the true state of the question, so far as a general comparison between the two operations is concerned. For it must be borne in mind that those cases which are lithotomised have invariably been picked; whilst lithotripsy has been performed on almost all patients as they have presented themselves. For lithotripsy to be successfully done, it is necessary that the stone be of moderate size, single, not too hard, and that the urinary organs be in a healthy state and free from irritation: and this is the state in which most of the cases have been, in which crushing has been done. In lithotomy cases, on the other hand, the surgeon has had to contend with all the difficulties of large multiple calculi, diseased bladders, and bad constitutions. Hence, in comparing the statistics of the results of lithotripsy with those of lithotomy, we compare the statistics of the results of operations performed under the

favourable circumstances on a series of selected cases, with those of cases taken indiscriminately and often presenting most unfavourable conditions.

Another cause of uncertainty with regard to the statistics of lithotritry is, that those we possess are chiefly from a professed lithotritist, M. Civiale, the accuracy of which has been denied in a very decided and emphatic manner by many of the leading surgeons in Paris, who have inquired fully into the matter; and the conclusions from which must necessarily be received with much hesitation in this country, where it is difficult to arrive at the real truth of the statements advanced on either side.

If we compare Civiale's statistics of lithotritry with those of lithotomy, as practised by the most skilful surgeons, Cheselden, Liston, and the Norwich operators, we should at once decide in favour of the crushing method; for Civiale states that out of 591 operations he had but 14 deaths, or 1 in 42.2; whilst, as we have seen, the most skilful lithotomists in this country, where the results of the cutting operation have been far more successful than elsewhere, can only boast of such a rate of mortality as 1 in 7.9, or at most in 10. But though the success is thus stated by Civiale to have been great in his own cases, the accuracy of this statement has been denied by other French surgeons, and it is certainly very different from what has occurred elsewhere. Thus of 162 cases operated upon by lithotritry by various surgeons in Paris, Civiale states that death resulted in 38, and a cure in 100 instances; the results of the remaining cases being unknown, or the cures incomplete. In this country it is impossible to say, even approximately, what the average mortality after lithotritry has been; for, with one exception, those surgeons who have had most experience in this operation have not published any account of their cases; but I believe there is a very general feeling that, in the different London hospitals in which it has been performed, lithotritry has not been a very successful operation. The same remark appears to hold good with regard to the Parisian hospitals; Malgaigne estimates the mortality from lithotritry in these institutions at 1 in 4, while he calculates that of private cases at 1 in 8. This difference between the results of this operation in hospital and private practice can easily be accounted for by the difference in the constitutions of the patients, and by their applying for relief in private in a less advanced form of the disease than in hospital practice. We find that the same holds good with regard to the results of lithotomy. Thus, Conlson states that Dudley lost only 1 in 36 of the private patients that he cut, Mettauer, 1 in 36½; Martineau, 1 in 42; and Mott, 1 in 50. These results are fully as favourable as Civiale's statistics of lithotritry, and show the influence that the constitution of the patient, and a proper selection of cases, may exercise upon the results of the cutting operation. The only statistics of lithotritry that we at present possess are those given by Sir B. Brodie, as the result of his practice, chiefly on private patients. That eminent surgeon states that, out of 115 cases of lithotritry—not all, however, on different individuals, the operation having been repeated more than once on several of the patients—he lost 9. Of these, death was directly attributable to the operation in 5 instances; and, in the remaining 4, it appeared to be dependent on organic disease, brought into activity by the shock of the operation.

Lithotritry, as has already been stated, cannot be applied to all cases of stone; but, in many that are unsuited to the operation, lithotomy may be done with success. In some cases, however, no operation can be practised in consequence of serious disease of the genitals, bladder, or kidneys, or of some visceral mischief that would necessarily interfere with the performance of any capital operation. The necessity of selecting cases of lithotritry is well

instanced by a statement that Civiale has given with reference to this point. This dexterous lithotritist considered that, of 838 calculous patients applied to him during a series of twenty years, only 548 were fit cases for lithotomy, and 290, or more than one-third, were not operated on by that method; of the last 332 cases included in this list, 241 were lithotomized, 36 being considered unfit for that operation. Of the 91 cases crushed, 28 were cut, and in 8 others lithotripsy and lithotomy were combined. Of these 36 cases subjected to lithotomy, Civiale lost 18, or exactly one-half. These figures show that lithotripsy cannot be considered the operation for stone; but must, even in the hands of the most delicate and successful practitioners, be in many instances replaced by the cut operation.

SELECTION OF OPERATION: LITHOTOMY OR LITHOTRIPSY.—The circumstances that must chiefly determine the surgeon in the selection of the proper operation that is to be performed are—1, the Age of the Patient; 2, Size and Character of the Stone; and 3, the Conditions of the Urinary Organs.

1. *Age.*—The age of a patient is an important element. As a general rule, it may be stated that at the middle and advanced periods of life lithotripsy is most successful; while, in early ages lithotomy is the preferred operation. In children under the age of puberty, the genito-urinary organs are undeveloped; the urethra is small, and the bladder narrow. These conditions not only necessitate the employment of instruments specially constructed of reduced size, and render great care in their manipulation requisite, but the narrowness of the urethra is especially apt to render the expulsion of the fragments of the crushed stone extremely difficult, and favour their impaction. If, in addition to this, we bear in mind the sensitiveness of the bladder in young children, and their restlessness under the repeated sittings which may be necessary, it can easily be understood that lithotripsy is neither an easy nor a safe operation in them; unless the calculus be so small—not larger than a cherry-stone—that it can be crushed and brought away at one sitting. Lithotomy, on the other hand, is so successful an operation in children, that the surgeon would gain nothing by substituting lithotripsy for it. Thus, of 35 children under 10, operated by Cheselden, only 1 died; and of 58 children cut for stone at St. Martin's, but 1 case proved fatal; and the average mortality of lithotomy in children is not more than about 1 in 14. Guersant, at the Children's Hospital in Paris, had performed lithotripsy in boys 18 times; 3 of the patients required to be afterwards subjected to lithotomy; and of the remainder there were 10 cures and 5 deaths—a lamentable mortality in operations for stone in children. Hence lithotomy, being much safer and far more applicable, should be preferred to lithotripsy in all patients under ten, and in those under twenty years of age.

At very advanced periods of life, the irritable state of the urinary organs, the tendency to the supervention of low cystitis, and the enlarged size of the prostate, are often such as to prevent the performance of lithotripsy with any prospect of success. At the same time, the success of lithotomy in advanced age has been very great in the hands of some surgeons. Thus Sequin states that, of 14 octogenarians whom he lithotomized, he did not lose one; of 27 septuagenarians, but two. Lithotomy, on the other hand, is very inapplicable in aged persons.

It is at the middle period of life, or in persons who, though advanced in years, preserve their powers unimpaired, that lithotripsy is most generally applicable and is most successful.

2. *Size and Character of the Stone.*—With regard to the size of the stone, surgeons generally recognise the fact that a small stone is more favourable to lithotripsy than a large one. All calculi below one inch in diameter may be crushed, provided other circumstances are favourable. In regard to larger calculi, it is, as a general rule, not well to attempt to crush a stone that is above one inch and a half in diameter; much, however, will depend on the composition and density of the calculus. The objections to lithotripsy in any given case are, not that a large stone cannot be broken, because in most cases this can be done; but that the fragments may be so large, angular, and sharp, as to require separate crushing to enable them to pass; that their quantity would be so great that the bladder would in all probability not be able to get rid of them; or that their presence, and the necessary operations for their disintegration and removal, would produce a dangerous amount of irritation. This is especially applicable to *lithic acid* concretions, giving a clear and ringing sound, the fragments of which do not disintegrate, but split up into sharp and angular spicula and scales. *Oxalate of lime* calculi, occurring chiefly in young people, comparatively rarely admit lithotripsy, but, when crushed, break up very readily; and, as there is usually a co-existing healthy state of the urinary organs, the cases have a favourable issue. *Phosphatic calculi*, which are soft and friable, and do not yield angular fragments requiring repeated disintegration, may, even if of larger size than that mentioned, be broken up. Some of the French lithotrisers are in the habit of breaking up friable phosphatic calculi of from fifteen to twenty lines in diameter. At the same time, the shattered state of system, and the irritable condition of the urinary organs in the phosphatic diathesis, often counterbalance the advantage that would otherwise have been derived from the character of the stone.

If there be several stones, the propriety of performing lithotripsy will depend in a great degree upon the size of the calculi. If these be small—not larger, perhaps, than small nuts, and not very numerous, the bladder being healthy—the operation may be performed with safety. I have removed successfully in a few sittings five or six calculi about half an inch in diameter. But if the calculi be larger than that, lithotripsy is not a very successful procedure; for, though each calculus may not be very large, yet the aggregate of the whole is considerable; and, besides this, the calculi will each require a separate operation, as it were, and may each contain a hard and possibly very resisting nucleus.

The case in which a calculus, after having been broken up into several fragments, has been left in the bladder, each fragment forming the nucleus for a new stone, is occasionally met with. Such cases are usually most successfully cut; but under favourable circumstances as to the condition of the urinary organs, they may be subjected to lithotripsy.

3. *The Conditions of the Urinary Organs* that influence the propriety of performing lithotripsy or lithotomy have reference to the state of the kidneys, the bladder, the urethra, and the prostate.

As a general rule, it may be stated that the greater the irritability and inflammatory tendency of the urinary organs, the less successful will lithotripsy be. The repeated introduction of instruments, however carefully and skilfully conducted; the presence of fragments of calculus, and their tendency to impaction or entanglement in the urethra, necessarily dispose to inflammation, even in the most favourable cases, and very readily excite it, if there be any tendency to such action existing in the parts. If, however, the stone be small, or of moderate size, and friable; the bladder healthy, and of good contractile power; the urethra capacious; and the patient of

sound constitution and quiet temperament, the stone may often be broken up and the fragments expelled with comparatively little suffering. In such cases, under a combination of favourable circumstances, such as these, lithotomy ought unquestionably to be preferred to lithotripsy.

If, however, the bladder be very irritable, or if the patient's constitution be an excitable one, so that he does not well bear the introduction of instruments; and more particularly if it be found that this local and constitutional sensitiveness, instead of being blunted by the methodical introduction of sounds or bougies, is rather increased thereby; and especially if the stone be of such size that several sittings would be required before the fragments could be expelled—lithotomy should be employed.

The existence of organic disease, however, about the urinary organs, constitutes the greatest obstacle to lithotripsy; and, when extensive, must constitute a complete bar to the performance of that operation. It is not easy, however, to determine the amount of local disease that should thus be held as contraindicating lithotripsy. On this point the opinions of surgeons differ much; and it is particularly in the management of these cases that the advantage of that tact and dexterity in the use of the crushing instrument, which habit can alone give, is so well exemplified.

The condition of the *kidneys* merits special attention. If these organs be diseased, as indicated by the presence of casts of tubes, or of a considerable quantity of albumen in the urine, or in any other way, the performance of a series of operations in the bladder would be likely materially to increase mischief in them, and consequently ought not to be undertaken. Organic disease of the kidneys is a more serious obstacle to lithotripsy than to lithotomy, on account of the prolonged nature of the operation, and the liability to sympathetic or propagated irritation in these organs, giving rise to purulent nephritis. It is not only by the operation increasing the mischief that harm might result, but also in consequence of the tenderness, low and diffuse inflammation of the bladder, prostate, and surrounding cellular planes, and to pyæmia, that always co-exists with kidney disease.

The conditions of the *bladder* that interfere seriously with lithotripsy are partly functional, partly organic. The functional derangements are of very opposite kinds; viz., a state of extreme irritability of the organ, or an abnormal want of sensibility of it—a state of atony. The organic consist of hypertrophied, fasciculated, sacculated, and permanently contracted states of the viscus, which is then most commonly irritable as well.

A *chronically inflamed or irritable state* of the bladder, more particularly if the organ be thickened and fasciculated, so that it will not bear the injection of a few ounces of tepid water, seriously interferes with the success of lithotripsy. A very irritable and sensitive bladder not only will be the seat of severe suffering on the introduction of instruments, but may not admit of holding sufficient water to make the operation a safe one, and readily become dangerously inflamed in consequence of the repeated introduction of instruments, and the presence of angular fragments. If, in the ordinary operation of sounding occasion much distress, if the patient cannot hold his urine long, and pass it in small quantities, if it be often or much loaded with viscid mucus, he will scarcely be able to bear the procedures necessary for the operation. In some instances, however, the irritability of the bladder may be overcome, and in all it may be much lessened, by keeping the patient in bed, and, as Sir B. Brodie recommends, daily injecting tepid water. If the bladder be *sacculated*, there will still greater risk of an unfavourable result; the sacs not only retain fragments of calculus, but also becoming the seats of unhealthy inflam-

tion, in consequence of which typhoid cystitis of a very serious character, followed by pyæmic symptoms and metastatic abscesses, may result. In such cases as these, lithotomy offers the only chance to the patient. The existence of a moderate amount of vesical catarrh, if the bladder be otherwise healthy, is no objection to lithotrixy.

In *encysted calculus*, lithotrixy is, for obvious reasons, inadmissible.

Atony of the bladder is not only a serious inconvenience, but a great source of danger in lithotrixy. It cannot in all cases be positively ascertained beforehand; though it may be suspected if the patient can hold his urine for a great many hours, and can bear without complaint the injection of a large quantity—eight or ten ounces—of fluid, the interior of the bladder feeling large and smooth to the sound. This condition chiefly occurs in old men of feeble habit of body; and, if ascertained, calls for the performance of lithotomy. As Civiale has pointed out, this condition may be a source of great danger after lithotrixy, the organ not possessing sufficient expulsive power to rid itself of the fragments with which it is encumbered, and of the presence of which it seems to be insensible, so far as the feelings of the patient are concerned; while its low vitality renders it peculiarly liable to subacute cystitis, excited by the presence of the fragments in the lower fundus. It must be borne in mind, that this atony of the bladder may, especially in feeble and aged individuals, be induced by the contact of the instrument, and especially by prolonged sittings.

If the *urethra* be the seat of stricture, or be very irritable, lithotrixy—which may require the frequent introduction of instruments of large size, and will entail the continued passage of fragments of calculus—cannot be performed. Stricture of the urethra does not, however, absolutely prevent the performance of lithotrixy, but only retards the operation until the constriction can be properly dilated. Should this, however, not be practicable to the full extent of the urethra, lithotomy on a small staff must be practised.

Moderate enlargement of the *prostate*, such as is habitually met with in elderly people, does not necessarily prevent the performance of lithotrixy; though it undoubtedly complicates the operation. The introduction of the lithotrite will be attended by considerable difficulty; and the fragments have a tendency to become lodged in a pouch of the lower fundus behind the enlarged gland. This more especially happens if the middle lobe be enlarged; and in these circumstances, though the stone may undoubtedly be crushed, yet the fragments would probably require to be removed by the scoop; the operation would consequently be very tedious and prolonged, and lithotomy would probably be found to answer best. Any inflammatory disease or abscess of the prostate, must necessarily prevent the performance of lithotrixy.

I have said nothing in this comparison between lithotrixy and lithotomy of the comparative painfulness of the two operations; for, as chloroform may be administered with equal advantage in both sets of cases, there is little difference in this respect, except that perhaps the advantage lies on the side of lithotomy, as being the shorter proceeding.

From all that precedes, then, it would appear that, useful as lithotrixy unquestionably is in many cases, it cannot be looked upon as a general means of treating stone in the bladder; being only applicable in favourable conditions of the urinary organs, to calculi of small, or, at most, but moderate size, and that a large number of cases will always be left in which lithotomy offers the sole means of relief.

CHOICE OF OPERATION OF LITHOTOMY.—The particular operation of lithotomy that should be had recourse to, will also vary according to the character of the stone. If this be of small size, and the patient an adult, the *median*

operation may advantageously be performed. If it be of moderate tolerably large size, and more particularly if the operation be practised on a child, the *lateral* appears to me to be the more applicable. If, again, calculus be of inordinate magnitude, the *suprapubic* or the *recto-vesical* operation should be the method selected. In fact, the surgeon should confine himself too exclusively to any one method of operating, but should adopt that procedure which appears to be best adapted to the special circumstances presented by the particular case before him, and should vary his method according to the state of the urinary organs, the age of the patient, the size and characters of the stone.

The *Result of Operation for Stone* will depend in a great measure upon the condition of the bladder, and the character of the stone. If the bladder be healthy, all symptoms will cease on the removal of the calculus, and the patient will be restored to perfect health. This usually happens when the calculus is of the lithic acid or oxalate of lime varieties, and of renal origin. If, however, the bladder be unsound, irritable, and disposed to the accumulation of phosphatic matters, the calculus being phosphatic, and chiefly, if not wholly, vesical in its origin, then an irritable state of bladder may be produced, or may speedily return after the operation, which will consequently be unproductive of little, or only of temporary benefit.

RECURRENT OF CALCULUS AFTER OPERATION.—This may take place from three distinct causes—1, in consequence of a continuance of the constitutional condition or diathesis, under the influence of which the calculus was originally formed; 2, from the descent of a renal calculus; and 3, from a fragment of calculus having been accidentally left in the bladder.

Relapse from the first cause is probably not very common, but its occasional occurrence shows the necessity of continuing constitutional treatment adapted to the particular diathesis, after the removal of the calculus from the bladder. It is relapse from this cause that probably occurs in cases of lithotomy; though even in this operation a fragment of calculus may be accidentally broken off during extraction, and left. Yet such an accident is not very frequent; for, if the calculus happen to be broken during extraction, the fragments, if not completely cleared out of the bladder, will usually be washed away through the wound by the flow of urine. The registers of the Norwich Hospital show 1 relapse in 38 cases; those of Lunenburg, 1 in 116 cases of lithotomy (Coulson).

After lithotripsy, on the other hand, relapse is far more common. In the practice of Civiale it has occurred about once in every tenth case. But estimate, high as it is, falls far below what happens in surgical practice generally. Civiale states that, of 36 private patients on whom he operated in 1860, 10 had previously been operated on, the stone having reappeared. This must evidently arise from some fragment of calculus having escaped detection and being left behind, thus constituting a nucleus for a fresh formation. The frequency of the occurrence of secondary calculus after lithotripsy, even in such practised hands as Civiale's, certainly constitutes an objection to that operation, and shows the necessity of the surgeon carefully examining the bladder before he pronounces the patient cured; even then watching him for some length of time, in order to meet the stone at its first formation, and to adopt means for its early removal. Lithotomy cannot always be said to be so complete a cure in all cases as lithotripsy. Not only is recurrence of calculus more common after the former than after the latter operation, but it not uncommonly happens that patients who have been lithotomised successfully, and in whom no recurrent calculus has formed, continue to suffer for a great length of time afterwards from very distressing

irritability of the bladder, which resists in the most obstinate manner all the ordinary methods of treatment. This is not the case after lithotomy: when a patient once recovers, his bladder regains its tone completely, and no trace of evil consequences is left.

Treatment.—In the event of a secondary calculus forming, whether after lithotomy or lithotripsy, most surgeons would feel disposed to extract it by the cutting operation. If lithotomy have previously been performed, this may be done again in the usual way, through the cicatrix left by the former wound; or the surgeon may adopt Liston's advice to cut through the right side of the perineum on a staff with a groove to the left of its convexity. As this procedure, however, would entail the use of the left hand for cutting and extracting, most surgeons would, I think, prefer either the operation through the site of the old wound, or else the median operation. Whatever procedure, however, is adopted, it should be borne in mind that the rectum may have become rather firmly adherent to the membranous portion of the urethra and the apex of the prostate, in consequence of the contraction of the old cicatrices, and may thus be endangered.

URETHRAL CALCULUS.

Calculi are not unfrequently met with in the urethra, especially in children, passing from the kidney, perhaps, into the bladder, and thence into the urinary canal, through which they occasionally escape, but in other instances lodge, more especially at the bulb or in the navicular fossa. These calculi are commonly of the lithic acid, lithate of ammonia, or oxalate of lime varieties; they are frequently round, but not uncommonly elongated or spindle-shaped. There is reason, however, to believe that calculi may form in the urethra. One of the most remarkable instances of this kind is represented in the annexed cut (Fig. 468), taken from a drawing in Sir R. Carswell's collection at University College. The stone here was of very large size—equal in bulk to two horse-chestnuts. In cases of tight stricture, sabulous or calculous concretions may occasionally be formed behind the constriction.

SYMPTOMS.—The presence of a calculus in the urethra may always be determined by the difficulty that is occasioned in micturition, and by the possibility of feeling the stone through the walls of the canal, or of detecting it by introducing a sound into the urethra.

TREATMENT.—The removal of these calculi may be effected either by extraction or by excision. When situated towards the anterior part of the canal, an urethral calculus may frequently be extracted by passing a long and very narrow-bladed pair of forceps down to it, by which it is seized and drawn forwards; occasionally, when it has reached the navicular fossa, it will not pass through the urethral orifice unless this be dilated by incision with a probe-pointed bistoury. If the calculus be too large to be extracted in this way, and appear to be firmly fixed, an incision may be made down upon it, through the urethra, by which it may be removed. It is a good rule not to make this incision in any part of the urethra anterior to the scrotum, for, in consequence of the coverings of the penile portion of the urethra being very thin, the aperture will probably not be closed, but a



Fig. 468.—Urethral Calculus.

fistulous opening left. When the stone is in the urethra, there would be some risk if the incision were made through the stone; it is better, if possible, to push the stone out of the portion of the canal, to cut down upon the stone. This operation may readily be done by passing an ordinary director, as far as the calculus end of it, so as to lay open the urethra, the calculus extracted by means of a pair of forceps should next be passed into, and retained in the bladder in order to lessen the tendency to the formation of a fistula.

It may happen that the calculus, impeding the urine, is several that are lodged in the bladder. The surgeon should, after removing the calculus, pass a sound into the bladder, to see if other concretions exist in that organ; if they are removed by extending the incision of the urethra into the bladder, by the lateral or perineal way I once saw Liston extract two vesical calculi that had blocked up the urethra.

PROSTATIC C

Prostatic calculus differs from all others in its composition, being formed in the ducts of the prostate principally of phosphate of lime (about 85 per cent. of the phosphate, sometimes, also, the concretion is said to be composed of carbonate of lime). It generally occurs in old persons, but I have met with in young subjects. From the history of vesical calculus, I extracted two prostatic calculi.

CHARACTERS. Prostatic calculus is somewhat triangular, smooth and polished, very hard, and seldom is it branched; though it may occasionally have been met with as I have seen, presenting a branched or irregular shape. But one or two exist, and they are not of the kind of cyst in the organ. They have been met with, the ducts of the prostate being studded with them.



Fig 460.—Prostatic Calculus.

SYMPTOMS.—Calculus in the prostate causes irritation in the perineum, sometimes, in fact, to the ordinary symptoms of calculus. It often occasions a tolerably free secretion of urine. On introducing a sound, this passes over the stone with a distinct grate or click before it is increased by the finger in the rectum, thus bringing the stone into more direct contact with the sound. In these cases the calculus is deeply imbedded in the prostate. If there be many small calculi, they may be felt by introducing the finger into the rectum. A crackling or grating sensation may be felt on the passage of the calculi, something like that produced by the passage of small stones through the urethra.

TREATMENT.—The treatment of prostatic calculus will depend upon the situation, size, and number of the concretions. When they are large, single, or at most two or three in number, readily struck with the sound, and situated on the urethral surface of the organ, the ordinary median operation may advantageously be performed, and the calculus removed with scoop or forceps. If the calculi be small and very numerous, not to be felt with a sound, but only through the rectum, it will be wiser not to have recourse to operation, which could not succeed in removing the whole of the concretions. In such circumstances, a palliative treatment directed to the subdual of the irritation of the prostate, and the use of the catheter to relieve retention, is the only course to pursue. When prostatic and vesical calculus occur together, the same operation will rid the patient of both forms of the disease.

CALCULUS IN THE FEMALE.

Stone is of rare occurrence in women; in London, certainly, I believe it is not often met with. Thus, South states that, during a period of twenty-three years, 144 males were operated on for stone at St. Thomas's Hospital, and only 2 females. In some districts, however, stone would appear to be more common in women than this. Thus, according to Crosse, at the Norwich Hospital, the proportion has been about 1 woman to 19 men. Civide states, as the result of his researches, that in the North of Italy, the proportion is as 1 to 18; and in France, as about 1 to 22. Calculus in women is most frequently deposited upon foreign bodies, accidentally or purposely introduced into the bladder, such as pins, pieces of pencil, &c.

At the University College Hospital we had not had a case of stone in the female for many years until 1855, when three came under my care in the course of a few months; and since that period several have occurred.

SYMPTOMS.—The symptoms of stone in the female closely resemble those that occur in the male, and its presence may usually be easily detected by means of a short and nearly straight sound, or a female catheter. It is often simulated very closely by the irritation occasioned by a vascular arethral tumour, or by an irritable bladder; but exploration of the viscous will always determine the diagnosis.

Calculus in the female bladder, if allowed to remain unrelieved, will not only occasion the various morbid conditions in the urinary organs that have been described as following the long-continued presence of stone in the male, but will give rise to diseased states peculiar to the female. Thus the stone may be spontaneously discharged through the urethra; if of small size, without any bad results following; but if large, by a process of ulceration, in consequence of which permanent incontinence of urine will remain: or it may slough through into the vagina: or lastly, it may offer a serious obstacle during parturition to the descent of the fetal head, when, if it cannot be pushed aside to be dealt with afterwards, it must be cut out or craniotomy be performed.

REMOVAL.—A stone may be extracted from the female bladder by one of three methods: 1, by Lithoclasty, through a dilated urethra; 2, by Lithotomy; 3, by Lithotripsy. These different operations cannot be employed indiscriminately, but each one is more especially adapted to certain kinds of calculus.

1. **LITHOLASTY** may be performed in two ways—either by simply *Dilating the Urethra* by means of a sponge-tent or dilator, or else by *Incising the Mucous Membrane* at the same time that the canal is being expanded.

a. *Simple Dilatation* of the urethra may be effected quickly by the introduction of a tent of compressed sponge, or a three-bladed dilator, which is

rapidly screwed up. In this way, in from a few minutes to two hours the canal may be easily dilated sufficiently to admit of the introduction of a pair of forceps, and the extraction of a calculus of moderate size. Some surgeons prefer a slow process of dilatation, continued through many hours; but appears to me to possess no advantage over the more rapid expansion. It has the very decided disadvantage of prolonging the patient's sufferings. The plan that I have adopted with most success is to introduce a sponge into the urethra two hours before the intended extraction; and then, when the patient is under the influence of chloroform, to dilate the urethra to the required extent, with a two- or three-bladed dilator.

b. *Incision* may be employed conjointly with dilatation, in order to prevent injurious stretching of the urethra, and consequent laceration of the mucous membrane. The incisions recommended with this view should be made after the urethra has been dilated to some extent, a probe-pointed bistoury being introduced by the side of the canal, and the mucous membrane divided. Brodie made an incision directly upwards; Liston downwards and outwards on each side—on the whole, I think, the best direction for the incisions, as more space may thus be obtained.

By dilatation, either alone or with incisions of the mucous membrane, small stones may readily be extracted; but in the removal of moderate-sized calculi, the great objection to this operation is the liability to incontinence of urine resulting from it. It is difficult to say to what extent the urethra may be dilated without incontinence resulting; this must necessarily vary in different individuals. It certainly can be expanded sufficiently to admit the introduction of the index-finger, and to allow of the extraction of a calculus eight or ten lines in diameter, without any evil resulting. The incontinence of urine that may be left after the removal of larger calculi than this is not by any means complete; but a weakened state of the sphincter of the bladder results; so that the patient cannot hold her urine for more than an hour or two at the most.

2. *Lithotomy in the female* may be performed in a variety of ways. There are, however, only two modes of practising this operation that appear to me to deserve serious attention, viz., the *Suprapubic* and the *Vaginal*.

The *Suprapubic* or *high* operation in women differs in no very material respect from the same procedure in men; except that it requires more care in consequence of the difficulty there is in causing the female bladder to retain a sufficient quantity of urine to make the viscous mucus sufficiently abundant to retain the stone at the pubes. The extraction of the stone is easy, as it can be raised into the grasp of the forceps by being pushed up from the vagina.

Vaginal Lithotomy is an operation easy of performance. It may be practised by passing a straight grooved staff into the bladder, pressing the stone well down against the anterior wall of the vagina, and fixing it there with the left index-finger. A scalpel is then pushed through the anterior wall of the vagina and inferior fundus of the bladder into the groove of the staff, which it is made to enter just behind the urethra, and is then carried backwards for about $1\frac{1}{2}$ inch; through the aperture thus made the forceps is passed, and the stone extracted. The incision into the bladder through the anterior vaginal wall should be brought together by metallic sutures, as in ordinary operations for vesico-vaginal fistula, and may thus be sufficiently closed, as has been done by J. Lane, Aveling, and others.

Both the high and the vaginal operations are easy of performance. In the high operation, there would, with care, be but little risk of injuring the peritonæum; and the chance of urinary infiltration, which is a serious danger in the male, may be prevented in the female by the introduction of a catheter

catheter into the urethra. The vaginal operation, though easier of performance, is open to the objection of possibly leaving a permanent urinary fistula. If, however, the lips of the incision have not been bruised by the forceps, or in the extraction of the stone, and be immediately brought together by metallic sutures, the risk of a fistula is, after all, not great. Vaginal lithotomy may, in some cases, be the only alternative. I extracted, by this operation, a calculus measuring eight inches by six in circumference, from the bladder of a woman twenty-three years of age, who had suffered from symptoms of stone from childhood. The stone by its size offered so serious an obstacle to the descent of the fetal head during parturition, that craniotomy had been rendered necessary; the anterior vaginal wall had been a good deal bruised, and I feared that sloughing of it might take place; hence I extracted the stone by the vaginal method.

3. LITHOTRITY in the female requires to be practised on the same principles as in the male. The details of the operation differ, however, in some important particulars. The chief difficulty in the performance of the operation in the female, consists in causing the bladder to retain urine or water that is injected into it. In consequence of this there is not only great difficulty in seizing the stone, the bladder collapsing and falling into folds around it, but also danger of injuring the mucous membrane with the lithotrite. In order to cause the bladder to retain the necessary quantity of urine, the pelvis must be well tilted up, and the urethra compressed against the lithotrite. It is well not to dilate the urethra before the introduction of the instrument, as the incontinence is thereby increased.

The ordinary male lithotrite is not a very convenient instrument to use in the female bladder, the handle being awkwardly long. This is especially the case in female children. Hence I have found it convenient to have a shorter instrument constructed, with which it is far more easy to manipulate in the female bladder. If urine or water cannot be retained, the calculus may more safely be seized and crushed by means of a small and strong-bladed pair of lithotomy-forceps; or, if the stone be larger, by a crushing instrument, made of the shape of that depicted in Fig. 449, but smaller and lighter.

After the stone has been crushed, the urethra (unless this have previously been done) may be dilated by means of the two-bladed instrument to a moderate degree, and the larger fragments removed by means of a pair of slender forceps. The whole of the fragments and detritus should be removed at one sitting. The shortness and wide capacity of the female urethra will readily allow the escape of any detritus that may unavoidably be left.

For all calculi in the female bladder, except those of the very largest size, this operation is the most applicable. I have in this way crushed and extracted at one sitting, a calculus (phosphatic) fully as large as a hen's egg. By this operation the stone may be removed piecemeal and at once, without the necessity of dilating the urethra to such a degree as to incur the risk of incontinence of urine resulting. Lithotrity may be had recourse to at all ages, in the very young as well as the old; I have crushed and successfully removed a large calculus in a child three and a half years of age. Although the urethra of a female child is not very dilatable, yet it can readily, by means of a sponge-tent, be enlarged sufficiently to admit an 11 or 12 lithotrite.

CHAPTER LXVII.

DISEASES OF THE BLADDER.

CONGENITAL MALFORMATION.

EXTROVERSION OF THE BLADDER, consisting in an absence of the anterior wall of the organ, with deficiency in the corresponding part of the abdominal parietes, is occasionally met with as a congenital malformation. The posterior wall of the bladder, being pushed forwards by the pressure of the abdominal viscera behind, forms a rounded tumour of about the size of a small child, just above the pubes. The surface of this tumour is red, vascular, papulated, evidently composed of mucous membrane; at its lower part the orifices of the ureters will be observed to open, and to discharge urine in drops or in a stream. For a full description of the mechanism of the passage of the urine in this malformation, I would refer to a case which fell under my notice, and in which I made a number of experiments to ascertain the rapidity of the passage of foreign matters through the kidney, reported in the *Medical Gazette* for 1845.

This malformation is incurable. Operations have been planned and performed, with the view of closing in the exposed bladder by various procedures, but they have rarely proved successful, and have terminated in some instances in the patient's death; they do not, therefore, afford much encouragement for repetition. The patient should, therefore, wear a properly constructed instrument to receive and collect the urine, consisting of a hollow shield strapped over the part, communicating by means of a tube with an India-rubber bottle, which may be attached along the inner side of the thigh.

CYSTITIS.

Idiopathic inflammation of the bladder is of rare occurrence. The disease most commonly originates either from traumatic causes, as from the use of instruments, the irritation of broken fragments of calculus, &c. or it may arise from irritation produced by the application of blisters, the administration of diuretics, or directly from the extension of gonorrhoea to the interior of the organ.

ACUTE CYSTITIS.—The *Symptoms* of cystitis consist not only in pain and weight about the hypogastric and iliac regions, with tenderness on pressure in these situations, and a good deal of constitutional irritation, but in the existence of extreme irritability about the bladder. So soon as a few drops of urine collect, they excite so much irritation in this viscus that it cannot be retained, and are expelled by a kind of spasmodic or convulsive effort, constituting stranguary, often accompanied by a good deal of tenderness and great suffering. The urine will be found to be high coloured, and mixed with more or less mucus or pus, and often tinged with blood.

Termination.—An acute attack of cystitis usually terminates in the chronic form of the disease, and thus gradually undergoes resolution. Occasionally, however, it terminates fatally; and when this is the case the patient's symptoms commonly assume an ataxic character, the tongue becoming brown and dry, the pulse rapid and weak, and the urine becoming offensive. On examination after death, it will commonly be found that the inflammation of the bladder has gone on to gangrene of the mucous

brane, to diffuse peritonitis, or to the formation of abscess, either in the substance of the wall of the bladder or between the bladder and the rectum, with perhaps infiltration of urine in the deep cellular tissue of the pelvis or the perineum.

Treatment.—The treatment of cystitis is very simple, the disease admitting of little being done in the way of medicines. The free application of leeches to the neighbourhood of the inflamed organ, long-continued soaking in warm hip-baths, the application of poppy fomentations or of laudanum and linseed-meal poultices, the injection of emollient enemata, and the copious administration of barley-water or mucilaginous drinks, will subdue the inflammation and afford the patient great comfort; to these means may be added the administration of antimonials with henbane or opiates. The only salines that are of much use are the citrate and nitrate of potass; and these must be given largely diluted.

CHRONIC CYSTITIS.—Acute cystitis commonly degenerates into the chronic form of the disease, the symptoms of which closely resemble, though in a modified degree, those that have just been described as characterising acute cystitis, and constitute one of the varieties of the “irritable bladder.”

The *Treatment* of chronic cystitis must be of a moderately antiphlogistic character, so long as inflammatory action keeps up; when once this subsides, and the disease falls into an asthenic condition, the management of the disease must, to a considerable extent, be modified. In the early stages, whilst there is tenderness and inflammatory action, leeches, warm hip-baths, poppy fomentations, mucilaginous drinks, with henbane, and some alkaline remedies, especially the liquor potassæ largely diluted, will be found most useful, the bowels at the same time being kept open by castor-oil and enemata. If there be much strangury of a spasmodic character, it will best be relieved by cupping or leeching the perineum, the internal administration of chloric ether and opiates, or the cannabis indica, and the use of opium suppositories.

IRRITABILITY OF THE BLADDER is a condition of very frequent occurrence. It is met with at all ages, complicates many of the diseases to which the urinary organs are liable, and arises from a great variety of causes.

Symptoms.—The patient has a frequent desire to pass urine, the fluid is generally ejected forcibly, or even spasmodically, and in small quantities at a time. Its passage is attended by pain of a burning, aching, spasmodic character, then constituting *Strangury*, sometimes confined to the body, sometimes to the neck of the bladder, not unfrequently extending to the point of the penis, or radiating round the pelvis and down the thighs. The urine may in the earlier stages, and in some cases throughout, continue to be healthy; but more commonly, after the disease has lasted some little time, it becomes loaded with mucus, muco-pus, or pus. When the mucoid secretion is abundant, viscid, and glutinous, the affection becomes *Vesical Catarrh*. In this stage its duration may be indefinite, more particularly in individuals advanced in years.

Symptoms of Vesical Catarrh.—In vesical catarrh the symptoms are made up of local irritation and constitutional debility. There is frequent desire to pass urine, which is usually ammoniacal and fetid, and is mixed with a large quantity of glutinous stringy mucus, which gives it a turbid appearance. The urine, on standing, separates into two parts, the upper being clear, but the lower consisting of a thick, viscid, slimy or gummy mucus, often semi-opaque and purulent in appearance; it sticks tenaciously to the bottom of the pot, and when poured out hangs from the edge in long

stringy masses. It is often mixed with a phosphatic kind. Its microscopic appearance is as follows.

This chronic form of inflammation of the bladder, when it terminates in death, results eventually with symptoms of

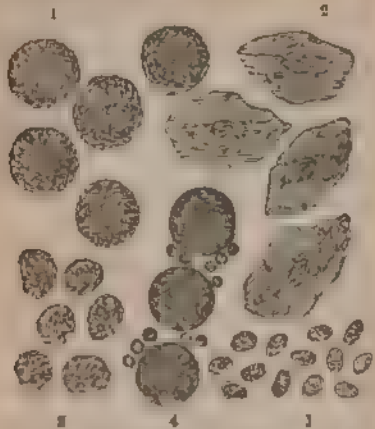


Fig. 470.—Microscopical Appearances in Mucous of Vesical Catarrh.—1. Mucous. 2. Epithelium. 3. Pus. 4. Organic Globules, met with in the urine.

folds and ridges, which become thickened by the pressure between them, so as to cause the somewhat the inside of one of the cavities of the columnar carinae. This farciculated compartment of long-continued chronic inflammation. As the organ becomes hypertrophied, in the disease, it usually becomes sacculated



Fig. 471.—Cyst in the Wall of the Bladder.

or lateral parts, of which are formed the foci of the wall, the least common kind of cyst, the mucous coat is pushed out of the cyst, the mucous protrusion (the accumulation of mucus, pus, and concretions, not

these situations. It is the retention of these cysts, where it undergoes decomposition, the great fetor of the urine in such cases.

Causes.—Irritability of the bladder may arise from a great variety of causes. These may be in men, women, or in children. The disease in men may be arranged under the following

1. **Morbid Conditions of the Urine.**—When the urine is acid and acrid, and loaded with lithates, it is especially apt to occasion inflammation, by pain and a frequent desire to expel the phosphates and oxalates in large quantities. Rarely, a source of irritability of the bladder

increased by the morbidly sensitive state of the nervous system usually co-existing with these conditions of the urine.

In *gout*, irritability of the bladder is not unfrequently met with. This appears in some cases to be owing to the acid and acrid character of the urine in that disease; in other cases, to the excitation of a distinct *gouty* inflammation of the bladder and prostate, co-existing or alternating with the articular form of the disease.

2 *Renal Disease*, more particularly the lodgment of a stone in the kidney, will often occasion sympathetic pains in the bladder, with much irritability of that organ, so as closely to simulate vesical irritability, or even to lead to a suspicion of the existence of stone in the bladder.

3 *Disease of the Bladder itself*, as a chronically inflamed state of its mucous membrane, will give rise to pain and irritation on the accumulation of a small quantity of urine in the organ, with a frequent desire for its expulsion. So also, when the interior of the organ is fasciculated, or contains cysts, and more especially if there be a tumour in a state of ulceration, a degree of morbid irritability will be induced, often of the most severe and intractable kind.

4. The *Lodgment of a Stone in the Bladder* will always, by its mechanical action, by its weight and pressure, by rolling about when the body is in motion, irritate the interior of the organ; and, in fact, the "rational symptoms" of stone in the bladder are simply those of irritability of that organ.

5. *Inflammation, Ulceration, Abscess, or other Diseases of the Prostate*, and inflammation, gonorrheal or simple, and abscess or stricture of the deeper portions of the urethra, may also not unfrequently be referred to as the occasioning causes of irritability of the bladder.

6. *Various Diseases in Neighbouring Organs* will occasion this condition. Amongst the most frequent are fissure and ulcer of the rectum and anus, piles, prolapsus, intestinal worms, gall-stones, and varicocele.

Diagnosis.—The diagnosis of irritability of the bladder is easily made; but it is often a matter of no little difficulty, though of the very first importance, to diagnose the precise cause of that irritability. This can of course only be done by a careful *surgical* exploration of the whole of the urinary organs, and often of the neighbouring parts; no mere inquiry into the nature of the symptoms, no chemical examination of the urine, can do more than establish the fact of the existence of "irritability of the bladder," and afford some evidence of a negative kind as to the absence of certain causes. But nothing short of a careful surgical exploration by means of the catheter, finger, and sound, of the urethra, prostate, and bladder, can enable the practitioner to state with absolute certainty on what this condition of irritability depends. I have repeatedly seen cases of stone in the bladder, and of prostatic disease, vainly treated by medical means for months as cases of simple "irritability of the bladder," the existence of the real cause of the symptoms having been overlooked altogether, until a proper surgical examination of the urinary organs was instituted. So closely, in fact, do the symptoms of vesical irritation, arising from gout or sympathetic with kidney-disease, simulate those that are occasioned by stone in the bladder, that it is impossible for the most experienced medical practitioner to refer them with certainty to the right cause without exploring this cavity. And, indeed, I have known several patients who had been successfully operated on for stone, and who, some years afterwards, suffered from gouty or other irritability of the bladder, imagine, but erroneously, that they were labouring under a recurrence of the calculus; so closely do the two classes of symptoms coincide in character.

Treatment.—The treatment of irritability of the bladder must reference to the removal of its cause, and the subduing of the local irritation by the use of demulcents and soothing means. It must be borne in mind that this condition is not a substantive disease, but is an accidental symptom resulting from the influence of a great number of very various causes, which must first be removed before the bladder can recover its normal sensibility and tone. When once the occasioning cause has been removed, whether that be a calculus, or gout, or prostatic disease, or a stricture, the remaining local vesical irritation may usually be removed by the use of weak alkaline and mucilaginous drinks, with henbane, cannabis indica, or opiates, a carefully regulated diet, warm hip-baths, and opiate suppositories in the rectum.

Treatment of Vesical Catarrh.—When vesical catarrh has come on, the disease has lost its active inflammatory character, appearing rather to consist of atomic exudation from the mucous membrane, a different plan of treatment will require to be adopted. In such cases as these, the greatest benefit will be derived from warm stimulating and balsamic drinks. Amongst the best are infusion of buchu or matice in large doses, either alone or conjoined with the balsams of Peru or copaiba. Turpentine, oil of turpentine, and tincture of the sesquichloride of iron, will all be found useful, and is often difficult to say beforehand which diuretic will suit best, and I lay down no precise rules to guide the practitioner in this respect, they may often be tried or alternated with advantage. In many cases temporary relief is obtained from each new remedy, which fails to be permanent. In the more advanced forms of the disease, when typhoid symptoms come on, bark and ammonia will be found most useful, together with the administration of the brandy-and-egg mixture. In these cases also of great importance to empty the bladder, by means of the catheter, of viscid mucus that accumulates in it, and the putrefaction of which, together with that of the residual urine, tends to engender the depressed state which the patient sinks. In some cases, this may advantageously be done by washing it out with warm water injections through a double catheter. In this stage of the disease, benefit may occasionally be derived from the employment of very slightly astringent injections. Amongst the most useful of these will be found the nitrate of silver, in the proportion of one grain to four or six ounces of tepid distilled water. Sir B. Brodie has advantageously employed water very slightly acidulated with nitric acid.

IRRITABILITY OF THE BLADDER IN CHILDREN appears to be an affection closely allied to the congestive and subacute inflammatory conditions of the different mucous membranes, as of the eyes, nose, and throat, that commonly occur in strumous subjects. In this disease the child passes urine with great frequency and with much pain; the urine is offensive, and usually phlegmatic; not unfrequently there is much uneasiness complained of about the groins and along the penis; in fact, many of the ordinary symptoms of gonorrhoea are present. On scouring the bladder, it will be found rough, inflamed, fasciculated, and often containing scabulous matters mixed with mucus. Occasionally there is a good deal of gastro-intestinal irritation, and unfrequently worms are present.

The *Treatment* should consist in attention to the general improvement of the health of the patient, in the removal of intestinal irritation, in the regulation of the digestive functions, and in the administration of opium in small doses, either alone or conjoined with a few minims of belladonna, at the same time that general antistrumous treatment must properly be carried out.

IRRITABILITY OF THE BLADDER IN WOMEN not unfrequently occurs, and often simulates stone so closely, that it is only after very careful sounding that the surgeon is satisfied that no calculus exists. This condition appears to be dependent on a morbidly sensitive state of the mucous membrane of the urethra and bladder that may arise from a variety of causes. In some cases it is a truly neurotic or hysterical condition. In other instances it is sympathetic; being connected with some local disease of the genito-urinary organs, with a vascular tumour at the meatus of the urethra, or with some congestive affection of the uterus, which will require to be cured before the bladder can be brought into a sound state. Prolapsus of the anterior wall of the vagina, drawing down the corresponding portion of the bladder, will keep up this condition; if so, the prolapsus must be cured by some plastic operative procedure. Under all circumstances, however, when this state has once been set up, it is very difficult to remove. In many cases it is undoubtedly due to the irritation produced by a morbid state of the urine, dependent on mal-assimilation, and usually connected with an excess of lithates.

Treatment.—In cases of this kind, careful regulation of diet, and the administration of potass with henbane or copaiba, will afford much relief; but the complaint is of a very chronic and intractable nature, and under the most careful treatment will often continue for years.

TUMOURS OF THE BLADDER, AND HEMATURIA.

POLYPI and **FUNGIOUS GROWTHS** are occasionally met with in the bladder, flat, pedunculated, or pyriform in shape. *Polypi* of the bladder may be composed of various elements; sometimes, but rarely, fibrous, at others villous; they may occur at all ages, and usually give rise to a certain degree of irritation in this organ, which is especially marked when they occur in the vicinity of its neck, where they may even cause retention of urine, and some of the symptoms of stone. *Fungous Growths* most commonly are of a malignant character, fibro-plastic, epithelial, or encephaloid; they then give rise to bloody urine, in which cancer-cells and debris may be found on microscopic examination, thus serving as a diagnostic mark of the nature of the disease.

Malignant fungus or cancer of the bladder is usually associated with similar diseases of the prostate or neighbouring structures, and in women may be secondary to cancer of the uterus. According to Walshe, it does not appear before the fortieth year.

These tumours, whether simple or malignant, occasionally become encrusted with phosphatic matter, deposited upon them by the urine; and then they will resemble still more closely a calculus when the bladder is sounded; from it, however, they may be distinguished by their fixed character, and by the impossibility of passing a sound around them. Some difficulty is often experienced in examining the bladder in these cases; for, as the fungous mass pushes back the posterior wall of the viscus, it has a tendency to elongate the prostatic portion of the urethra and the neck of the bladder, so that a very long instrument may be required to reach it.

Little can in general be done in the way of *Treatment* in this disease; though the example of Civiale might, in some cases, be advantageously followed, who removed a small growth seated at the neck of the bladder by seizing and twisting it off with a lithotrite. Warner has recorded a case in which a tumour of this kind, of the size of an egg, was tied in the bladder of a woman after dilating her urethra.

HEMATURIA.—The admixture of blood with the urine may usually be recognised by the colour that it communicates to this fluid. If the blood be in large quantities the urine will be dark brown, chocolate, or mahogany coloured, and will stain red the bottom of the utensil or a piece of blotting-paper. If it be in smaller quantities, the urine will be brown; in other cases it will be little discoloured, but will deposit a red or brown sediment on standing. Heat coagulates the blood into a brownish deposit, leaving a clear supernatant fluid; and, under the microscope, blood discs may be detected in large quantities.

Hematuria is a symptom of disease existing in some part of the urinary apparatus; but it often assumes so great an importance from the loss of blood induced, that it must be looked upon as a substantive disease.

Sources.—Hematuria may arise from 1, the Kidneys; 2, the Bladder; 3, the Prostate; or, 4, the Urethra; and from each source several different causes will produce it. The recognition of the precise morbid condition that gives rise to hematuria is of the first importance in its treatment.

1. *Hemorrhage from the Kidneys.*—When occurring from the kidneys, the bleeding may be the result of congestion of those organs, of the presence of a calculus in them, or of its descent down the ureter, or of malignant disease. The renal congestion may be inflammatory or passive; in either case the urine will present, after the discharge of blood has ceased, evidence of chronic renal disease in the form of albumen, pus, or casts of tubules. If the hemorrhage arises from renal calculus, either stationary or descending, the symptoms of that morbid condition, described in p. 1069, will be well marked.

2. *Hemorrhage from the Bladder.*—If the blood proceed from the bladder, it may be the result of congestion of the mucous membrane, of the presence of a calculus, or of the ulceration of malignant disease. When it depends on vesical congestion, there will be a sensation of weight in the region of the bladder, with frequent desire to pass urine; when on calculus, the symptoms of the existence of stone will be present; and when on malignant disease, the discharge of pus, and of the debris of the ulcerating tumor, will afford unequivocal evidences of the true source of the hemorrhage.

3. *Hemorrhage from the Prostate.*—If the prostate be the source of the hemorrhage, the discharge may be occasioned by congestion of that organ, by its ulceration, simple or malignant. In these cases, exploration of the rectum and urethra will indicate the true cause of the bleeding.

In general, when the hematuria is renal, the urine will be undecanted, mixed with the blood; when it is prostatic or vesical, the first urine passes, or that is drawn off by the catheter, will be pale and free from blood; the last; and at the termination of the flow nothing but blood may be obtained.

4. *Hemorrhage from the Urethra.*—The bleeding may arise from congestion of the mucous membrane, from inflammatory irritation of the canal, or may follow rupture of the walls of the canal, consequent on injury from the introduction of instruments.

Treatment.—The treatment of hematuria must necessarily have reference to its cause. If it arise from inflammatory congestion of the bladder, or prostate, cupping, or the application of leeches over the affected part, demulcents, and saline drinks, will be most efficacious; if from passive congestion, it will usually be found that the hepatic portal system is affected, and a few doses of mercurials, followed by the use of astringents, speedily induce a cessation of the hemorrhage. The astringent that exerts the most marked influence in arresting hematuria, when that disease is purely passive, is undoubtedly gallic acid. This may be given in ten grain doses, frequently repeated in infusion of buckthorn or uva ursi.

As a general rule, it is better not to use the catheter in these cases ; but sometimes the bladder becomes distended by a large soft coagulum, filling up its interior, and causing it to reach to the umbilicus, forming a rounded solid tumour, like a gravid uterus. Under such circumstances, the more fluid contents may be drawn off by a large catheter, and the more solid portions broken down and washed away by the injection of tepid water through a large-eyed or double-current catheter. If decomposition occur in the coagulum, giving rise to the formation of flatus in the bladder, a weak tepid saline solution, to which a little creasote has been added, may advantageously be used. I have known abundant hematuria to continue for many years—for twelve or fourteen—without any very evident cause, and without deranging the general health to so great an extent as might be expected from so continuous and copious a loss of blood.

ATONY OF THE BLADDER.

Atony of the Bladder may occur with the opposite conditions of retention and incontinence of urine, according to the part of the organ that has lost its contractile power. When the body of the bladder is paralysed, whilst the neck preserves its contractility, retention of urine will ensue in consequence of simple inability on the part of the organ to expel its contents, and not from the existence of any mechanical obstacle to the outward flow of the urine. When, on the other hand, the neck of the bladder is paralysed, whilst the body of the viscus retains its contractility, the urine cannot be retained, but dribbles away involuntarily, thus constituting incontinence.

RETENTION OF URINE.—Loss of tone in the body of the bladder, leading eventually to its paralysis, not unfrequently occurs in old age as the result of simple diminution of muscular power ; or it may happen as a consequence of fever ; or as one of the symptoms of paraplegia, from whatever cause arising. It may occur suddenly in cases of injury, in which the lower part of the spinal cord is paralysed.

Symptoms.—When this condition comes on slowly as the result of disease, the patient usually finds that the urine escapes in a dribbling manner ; that there is some difficulty, and at last an impossibility, in emptying the bladder completely ; and that there is not that forcible ejection of the last drops of urine that is characteristic of a healthy tone in the organ ; at the same time there is not unfrequently a tendency to the dribbling away of a few drops towards the end of the emission of urine, and after its apparent cessation. There is also an occasional escape of urine at night. When complete retention occurs, whether this take place gradually or suddenly, the bladder slowly enlarges, rising at last out of the pelvis into the abdomen, stretching up into the hypogastric region, reaching even as high as the umbilicus. On examining the lower part of the abdomen, the organ will be felt hard, elastic, rounded, and pyriform in shape, projecting above the pubes, and feeling much like an enlarged uterus. In this situation, also, percussion will elicit a dull sound ; and on exploring the part through the rectum, the bladder will be found to project in this direction also ; and on tapping with the fingers above the pubes, fluctuation may be felt through the wall of the gut. After the bladder has once become distended, it commonly happens that a quantity of urine continues to dribble out of it ; in fact, the amount that escapes in this manner may be very considerable, though the retention continue unrelieved. This *retention with dribbling* is a condition of much practical importance, as the continued escape of urine may lead the patient, and even the surgeon, to overlook the true nature of the disease ; the more so, as in elderly people retention slowly induced often occasions but little incon-

venience. I have drawn off nearly a gallon of urine from a patient in whom it had not been suspected that retention existed, in consequence of the continuance of this dribbling. In women, retention is not by any means common as in men, but the bladder will sometimes attain an enormous size, rising as high as the umbilicus; and such large bladders have been known to grow under the supposition of the tumour being an ovarian cyst, or even of cancerous growth. I once witnessed such a case in which the surgeon, to his regret, on tapping the tumour, drew off a quantity of clear and healthy urine instead of ovarian fluid; fortunately no bad effects followed. Retention with dribbling occurs in consequence of the bladder, as it rises above the pelvis, elongating its neck; and as the body becomes bent forward, the pubes a sharp curve or angle is formed at the junction of the neck and body of the viscus, through which a small body of urine continues to pass away, and escapes rather by its own gravity than by any expulsive action of the part of the patient.

Diagnosis.—Retention from atony can easily be diagnosed from retention from obstruction: for, on introducing the catheter when the patient is lying on his back, the instrument will not only readily enter, but the urine will simply flow out in a slow uniform stream, not being projected as in obstruction, by the contraction of the walls of the organ, but rising and falling in accordance with the respiratory movements. The urine that escapes in a case of retention will always be found to be high-coloured and very ammoniacal, its specific gravity is also considerably increased, in consequence probably of the retention of its more watery constituents.

Results.—The habitual retention of a small quantity of urine in the bladder which is incapable of discharging completely the whole of its contents occurs much more frequently than is suspected. The quantity retained will vary from an ounce to half a pint: the patient believes he has emptied his bladder, but the introduction of a catheter proves the existence of retained urine. This condition will be a source of great inconvenience, and eventually of disease, to the patient. In consequence of the bladder never being completely emptied, there will be frequent, and almost irresistible calls to pass urine, so as to simulate irritation of the bladder. The retained urine becomes offensive, ammoniacal or foetid, and mixed with mucus or muco-pus. The constituents of the urine, when become absorbed, give rise to impaired nutrition, and, being eliminated through the skin, irritate it and occasion intractable forms of skin-disease. The continuance of complete retention of urine from paralysis of the bladder, will probably give rise to fatal consequences, a violent inflammation taking place in the mucous membrane of the organ, which passes into a sloughy condition, accompanied by symptoms of a typhoid type; in some instances coma supervenes, owing to the poisoning of the system by the absorption of the urinary constituents. Even though the retention is relieved, this condition is apt to come on; vesical catarrh with febrile action supervening, the tongue becoming brown, and low fever setting in. It is very seldom that the bladder ulcerates or bursts when the retention is continued from paralysis of that organ independent of any mechanical obstacle. Continued dribbling preventing this consequence.

Treatment.—The treatment of this form of retention must have reference to the cause of the atony or paralysis of the bladder; but under all circumstances the urine must be drawn off regularly. A large gum catheter must accordingly be introduced twice a day, even though retention be not complete, in order to empty the bladder of the small quantity of residual urine left in it after the apparent evacuation of its contents.

in doing this, care must be taken that the beak of the instrument properly enters the body of the bladder, which is further removed from the pubes than usual; for it will sometimes happen that it may enter the dilated prostatic part of the urethra, or elongated neck of the bladder, when, an ounce or two of urine escaping, it may be supposed that there is no more left, though in reality the viscus is immensely distended. In order to get the catheter well in, its point should be closely hooked round the pubes and raised by depressing the handle between the thighs. In cases of paralysis, the catheter should not be allowed to remain in the bladder, lest the pressure of its point against the mucous membrane increase the tendency to low cystitis, or give rise to sloughing.

If the retention arise from paralysis dependent on injury or disease of the spine, it will occasionally be found that strychnine, either administered internally or applied endermically, will tend to lessen it. If the atony arise from old age, the administration of cantharides, or the application of a blister to the sacrum, may be of use. In some cases the application of cold to the inside of the thighs or to the abdomen will facilitate the contraction of the organ; hence it is the custom of some old men labouring under this affection to press the chamber utensil against the inside of the thighs, and I have known a patient find more relief from sitting on the marble top of his commode, than in any other way.

INCONTINENCE OF URINE arises from weakness of the neck of the bladder, in consequence of which there is not sufficient power to hold the contents of the organ, and the urine dribbles out. In most cases, the sphincter-like action of the neck is perhaps not quite lost, so that a small quantity is ejected from time to time; the urine, in fact, escaping as soon as enough has accumulated to overcome the slight resistance offered by the partial contractility of this part of the bladder. When there is paralysis of the body of the bladder as well as of the neck, the urine dribbles out as fast as it is poured in by the ureters.

Causes.—Incontinence of urine, consequent upon weakness of the neck of the bladder, may arise from a variety of causes; it is most frequent in children, in whom it occurs during sleep, the patient losing the command over the sphincter as soon as a small quantity of urine has accumulated behind it. In old people it may arise from simple debility, and is commonly associated with a tendency to retention. In many cases it is sympathetic, dependent on the irritation of piles, stricture of the urethra, or stone in the bladder; and occasionally it results from nervous causes, more particularly in women of an hysterical temperament. Over-distension of the bladder will occasion incontinence of urine, not from paralysis, but from a kind of strain of the muscular structures of the part; in this way a patient, who from circumstances has been unable to empty his bladder for a considerable time, may suffer from incontinence. In children of a strumous habit, incontinence of urine is very apt to occur, the child wetting its bed an hour or two after it goes to sleep. In such cases, the urine will generally be found to be loaded with lithic acid crystals.

Treatment.—The treatment must depend upon the cause. When the incontinence occurs in weakly children, if it be not connected with worms or gastro-intestinal irritation, which should then be removed, the administration of tonics will be found useful—either quinine or the tincture of sesquichloride of iron, alone or conjoined with tincture of cantharides. If there be irritation of the mucous membrane of the bladder, the administration of alkalis, in conjunction with a tonic, as the potassio-tartrate of iron, or a little opatha mixed with honey, will be found very serviceable. Cold

sponging, light clothing at night, and means calculated to break the habit, such as waking the child at the time at which it generally occurs, changing his position in bed, &c., should not be omitted. When it occurs at an advanced period of life, if there be any source of sympathetic irritation, this must be removed; if none can be discovered, tonics, especially iron, with strychnine and galvanism, must be had recourse to, together with cold douching or shower-baths.

HYSTERICAL RETENTION AND INCONTINENCE OF URINE not unfrequently occur in nervous girls, and require to be treated by antihysterical remedies, amongst which preparations of sesquichloride of iron, either alone or with valerian, will be found most useful. Cold douches are also of great use. In cases of hysterical retention, it may sometimes be necessary to use a catheter; but under such circumstances it is well not to employ this instrument too frequently, as the patients are apt to get into the habit of its introduction, and will, with that morbid propensity that characterizes hysteria, continue for a length of time to require its introduction. As to themselves, though the bladder may become much distended, it will burst, but will probably empty itself without further trouble, particularly if the patient be put into a tub and well douched over the hip and with cold water. In some cases, these morbid conditions in women appear to be connected with some local irritation about the urethra or uterus, and then proper treatment must be directed to these organs before the bladder can be removed.

PAINFUL CONDITIONS OF THE BLADDER.—The bladder is often the seat of severe pain, either continuous or remittent, without any disease being discernible in it on the closest examination; the pain being either a kind of neuralgic condition, especially occurring in hysterical or hypochondriacal patients; or else being sympathetic with, and dependent on, disease at some distance, as in the kidneys, uterus, rectum, &c. At the same time it may be borne in mind, that the secretion of acid or irritating urine will, in some individuals, be a source of much and constant suffering; and that any disease seated about, or coming into contact with, the neck of the bladder, as the prostate, &c., is especially apt to give rise to severe suffering, and will, in some cases, be accompanied by frequent desire to micturate, with much distress about the part.

CHAPTER LXVIII.

DISEASES OF THE PROSTATE.

The prostate is subject to Acute and Chronic Inflammation, to Hypertrophy, to Scirrhus, and to the formation of Calculi.

PROSTATITIS.

ACUTE INFLAMMATION OF THE PROSTATE, OR PROSTATITIS, very rarely occurs as an idiopathic affection. When met with, it is usually the result of gonorrhoea, or of the use of stricture-instruments, more especially in middle-aged men.

Symptoms.—These are deep-seated dull pain, with heat and weight in the perineum, a frequent desire to pass urine, and very great and acute pain accompanying the act; in fact, the irritability that is set up about

neck of the bladder is perhaps the most marked and distressing feature in the disease. These symptoms are, however, common to various inflammatory affections of the urinary organs, and they can only be distinctly referred to the inflamed prostate by rectal exploration. On introducing the finger into the gut, the prostate will be found much enlarged and exquisitely tender to the touch; and the patient often suffers considerably from the pressure of the inflamed organ upon the rectum during defecation.

Treatment.—This should be of an active antiphlogistic character, so as to prevent, if possible, the formation of abscess. The perineum must be cupped or well leeches; warm hip-baths and poppy fomentations assiduously employed; and salines with antimony administered. In this way, the formation of abscess within or around the prostate may, in many cases, be prevented.

PROSTATIC ABSCESS may happen either as a consequence of acute inflammation running into the suppurative stage, and in this way it is not very unfrequently met with as a complication of gonorrhoea; or it may occur with comparatively little antecedent inflammation—as sometimes happens in pyæmia, or if the organ be accidentally bruised during lithotomy. In these cases, abscess perhaps as frequently forms in the cellular envelope as in the organ itself. Idiopathic suppuration of the prostate, irrespective of any of the above causes, is, however, of rare occurrence; but it may occur in individuals of broken health, the matter then usually accumulating in large quantity, and discharging itself into the bladder.

Symptoms.—When inflammation of the prostate terminates in abscess, rigors, with strangury, and perhaps retention of urine, occur. In many cases the perineum becomes brawny; in others, tenderness of the gland and deep fluctuation may be felt through the rectum. When left to itself, the abscess most usually gives way into the urethra or neck of the bladder; but it may, especially when occurring in the prostatic capsule, open externally into the perineum, or even into the rectum. In many cases, the abscess presenting on the urethral surface of the prostate is burst during the introduction of the catheter, used for the relief of the retention of urine induced by the pressure of the tumefaction; the matter escaping along the side of and through the instrument.

Treatment.—It not unfrequently happens that the first certain indication afforded to the surgeon of the formation of a prostatic abscess is the escape of pus by the urethra, or mixed with the urine, so as to give this fluid a thick milky appearance. In such circumstances, the only available treatment is that which is directed for the relief of the strangury and local vesical irritation on ordinary medical principles, such as have already been described. But if, as sometimes happens, the pus come forwards into the perineum, then a more decided line of treatment is required. In these cases a hard brawny mass will be felt lying deeply on the side of the perineum; and into this a deep incision should be made. The surgeon must not wait for fluctuation, but must cut deeply in the direction of the matter, keeping, however, as nearly as possible in the mesial line, with the back of the knife towards the rectum. Even if no pus escape at first, it may do so if the part be well poulticed for a few hours; and thus communication with the urethra or rectum may be prevented.

RETENTION OF URINE FROM PROSTATITIS.—In prostatitis, retention may occur from the swelling of the organ, from the infiltration of exudation-matters around it, or from the formation of pus in it. In these cases the neck of the bladder will be carried to a considerable distance from the surface, and may very probably not be reached by an ordinary catheter, which may be buried up to the rings and yet not enter the cavity of that

organ. In these circumstances, a silver prostate-catheter should be employed; and this must be carefully introduced, first, by entering cavity of an abscess which has already burst *per urethram*, it might be supposed to have entered the bladder itself. In introducing the instrument under these circumstances, care should be taken to keep its point constantly in contact with the upper surface of the urethra, and to hook it round the pubes. The upper surface of the urethra is a sure guide to the bladder; any abscess, false passage, or irregularity of direction, will always first affect the lower aspect of this canal, being surrounded by yielding strata, whilst the upper part, being firmly supported by bone and ligament, can so readily alter its direction.

CHRONIC ENLARGEMENT OF THE PROSTATE.

Chronic Enlargement of the Prostate may be looked upon as a disease, seldom occurring before the age of fifty, and being commonly with after this. At that period of life, as Sir B. Brodie observes, the hair becomes grey and scanty, when atheroma begins to be deposited in coats of the arteries, and when the *areus senilis* forms on the cornea, the prostate often becomes increased in size. At the same time, however, changes take place in the genito-urinary system; thus the urethra becomes dilated and the bladder thickened; and, unless the enlargement of the prostate advance in too great a proportion to the other changes, so as to interfere with the free escape of the urine, no disease can properly be said to be established. If we look upon the diseased enlargement of the prostate as such an amount of hypertrophy of this organ as interferes seriously with the discharge of the urine, we shall probably not find it so frequent in old men as is generally supposed. Guthrie states that it is not common found in the pensioners at Greenwich Hospital. H. Thompson found an enlargement appreciable after death existed in 30 per cent. of those above the age of fifty; but that such a degree of enlargement as to give rise to symptoms during life was only met with in 12 per cent. of those he examined. Though age must be looked upon as the primary cause of particular hypertrophy of the prostate, there can be little doubt that it is predisposed to by any continued source of irritation of the urinary organs, such as gonorrhoea, strictures, or hard living.

CHARACTERS.—Enlargement of the prostate is principally due to the degeneration of that organ, with phosphatic deposits in it, the texture of the gland is usually indurated, though sometimes it has been found softer and looser than natural.

The enlargement may occupy the whole of the organ, causing its increase to that of a large egg or small orange; or it may be confined principally to the lateral lobes, which may either both or singly become hypertrophied. When this is the case, the urethra becomes greatly elongated, tortuous, winding round the promontories formed by these lobes, and sometimes assuming the form of a sinus, being irregularly dilated, or a considerable change may take place, not only in the direction but in the shape of the canal, which becomes elongated from above downwards into a kind of S-shape, or else is flattened out laterally. In all cases of enlarged prostate, however be its shape, the corresponding portion of the urethra becomes enlarged and wider than natural. The elongation of this canal is due to the enlargement of the prostate, in which the canal that traverses it necessarily partake; and its expansion to the outward growth of the organ. So capacious does this portion of the urethra sometimes become, that it will hold two or three ounces of urine, and in consequence of its elongation

carry the neck of the bladder upwards, and behind the pubes, to a considerable distance from the surface.

The urethral portion of the prostate may become greatly enlarged in size, with or without accompanying hypertrophy of the lateral lobes. It then usually assumes a nipple like appearance, but sometimes becomes constricted at the base and expanded above, so as to be truly pedunculated, constituting at last a round and solid tumour overlapping the urethro-vesical orifice, as in the accompanying cut (Fig. 472), which represents the prostate thus enlarged; the "third" or "median lobe" forming a pedunculated tumour, which acted like a valve—obstructing the exit of the urine from the bladder, though it did not offer any obstacle to the introduction of a catheter. Occasionally the verumontanum alone appears to be affected, forming a kind of thickened valvular projection, which interferes materially with the flow of the urine.

The nature of the tumours met with in the prostate has been carefully studied by Thompson. The following remarks embody his observations.

"The existence of solid tumours of different kinds is by no means rare in the prostate. They were pointed out by Sir E. Home, and by him supposed to be of the nature of apoplectic clots. Subsequently they have been regarded as fibrous tumours; and more lately it has been shown that some possess a structure approaching very nearly to that of the secreting tissue contained in the prostatic substance around. It is shown that enlargement of the prostate is very frequently associated with the development, more or less marked, of such growths in some one of three forms; in short, that the production of defined tumour is more frequently than otherwise the essential element of the pathological condition known as hypertrophy of the prostate. Of fourteen enlarged prostates, six exhibited numerous fibrous tumours in the substance of the lateral lobes; the others showed polypoid enlargements, single, binary, or multiple, springing from the 'posterior median portion.' The varieties may be briefly noticed as follows:—

"1. A simple fibrous tumour, small, nearly isolated, made up of closely packed organic muscular fibres, with areolar tissue, intimately resembling those found imbedded in the walls of the uterus.

"2. A tumour composed of the same elements as the preceding, but containing, in addition, some of the glandular substance of the prostate, more or less imperfectly developed. This also may be imbedded, with or without a cyst, seeming sometimes to partake more of the character of a local enlargement, limited to a small portion or lobule of the prostate tissue, and only partially isolated. Although separating this class from the previous one for facility of reference, it is more than probable that the two nearly merge into each other at the adjacent limits, the latter approximating to the former by insensible gradations; so that some tumours which appear to be purely fibrous at first may be found to exhibit slight traces, in parts of their structure, of the glandular element. In all, however, the basis is the organic muscular fibre.

"3. A tumour composed entirely of the ordinary structures of the prostate



Fig 472.—Enlargement of Urethral Portion of Prostate

fully developed, and enjoying activity of function in common with the rest of the organ. It assumes a pyriform shape even in its earliest stage, and springs from the posterior median portion. It may vary in size from that of a pea to that of a middle-sized pear. The analogy between these and the polypoid tumours of the uterus are considerable, pointed out by Velpeau and others, modern researches seem to indicate them as plainly."

MECHANICAL EFFECTS.—These enlargements are productive of various inconveniences with regard to the passage of the urine, giving rise either to retention or to incontinence, or to a kind of mixture of both. While the lateral enlargements cause the urethra to assume a somewhat tortuous course, the middle lobe, if hypertrophied, may readily occasion retention, by projecting against the entrance to this winding channel, falling over it like a valve whenever the patient attempts to pass urine (Fig. 472). Then, again, if the middle lobe continue small whilst the enlargement of the lateral lobes takes a direction up towards the bladder, well as they go, the vesical neck may be so dilated that incontinence and a continuous dribbling will occur through a kind of fissure that extends between the lateral lobes.

The obstacle offered to the passage of the urine by an enlarged prostate



Fig. 171—Result of Enlarged Prostate. Bladder thickened and enlarged. Ureters dilated. Chronic Disease of Kidneys.

will usually eventually give rise to a chronically thickened, fasciated, and sacculated bladder, the fundus of which descends below and behind the enlarged gland, forming a large pouch that cannot empty itself, in which mucous and morbid secretions are apt to collect. The ureters often become dilated and the kidneys chronically diseased, a series of changes well illustrated by the annexed cut (Fig. 473).

SYMPTOMS.—The symptoms of an enlarged prostate arise primarily from the mechanical obstacle offered to the escape of the urine. The first symptoms usually consist in the feeling of a necessity to strain slightly before the urine will flow, and then, after the bladder has been apparently emptied, in the involuntary escape of a small quantity of urine. The patient also finds that he is much longer than usual in emptying the bladder, for, though the stream flows for a long enough so soon as it has once begun to escape, yet it cannot be properly projected, the viscus having, to a certain extent, lost its tone.

About this time changes begin to take place in the urine, which now becomes somewhat fetid, even while it continues acid, and is often mixed with more or less viscid, stringy mucus; though in many cases it is clear, pale, and not in any way altered in character. The symptoms often come on in a very gradual manner, the patient straining and

experiencing much difficulty in the extrusion of the urine for months or even years before retention will occur. As the disease advances and the bladder becomes less capable of emptying itself, two or three ounces or more of residual urine are left, which becomes dark, mixed with adhesive, sticky mucus; and, at last, if the mucous membrane of the bladder fall into a chronic state of inflammation, it assumes a milky appearance from an admixture of pus, and becomes horribly offensive, blackening the silver catheter.

The exact condition of the enlarged prostate can only be ascertained by examination through the rectum and urethra. By rectal exploration with the finger, the degree of enlargement of the lateral lobes can best be ascertained; though, as in many cases the end of the finger cannot reach the further extremity of the gland, it will be impossible to say to what extent the hypertrophy has extended. The urethral exploration must be conducted by means of a long gum-elastic or a silver prostatic catheter, and will afford information that rectal exploration cannot give; and by it are ascertained approximately the size of the middle lobe, and the condition of the urethra as to elongation and curve.

RETENTION OF URINE constitutes the great danger in advanced cases of enlarged prostate. It commonly comes on gradually, the patient having for some time before experienced considerable difficulty in passing his urine, and he will often find that the more he strains in his efforts to do this the less readily will it come away; whereas, when he remains quiet, it will usually flow with more freedom. The retention from prostatic enlargement is of the mixed kind, there being always more or less incontinence conjoined with it. When the bladder has become tense, and the prostatic portion of the urethra put upon the stretch, the escape of a certain quantity of urine will take place, until, by the relief of the tension of the over-distended bladder, the parts about its neck and the enlarged prostate become relaxed, so that they again fall together, and thus, the urethra resuming its tortuous condition, the outlet is occluded. In these cases error may always be guarded against by the surgeon feeling the enlarged bladder rising up above the pubes, and reaching perhaps as high as the umbilicus. This condition is an extremely dangerous one, not so much from any risk of the bladder or urethra giving way in consequence of over-distension, which very rarely happens in retention from enlarged prostate, as from the occurrence of paralysis of the bladder, or the probability of the early setting in of chronic inflammation of its mucous membrane, which is specially apt to take place. The bladder has usually not emptied itself completely for a considerable length of time before the retention is complete; and a quantity ofropy mucus, having collected in the fundus behind the prostate, whence it cannot be expelled, becomes putrid, and thus disposes to the supervention of that form of chronic inflammation of the vesical mucous membrane, which, occurring in a depressed state of the system, is especially apt to give rise to a brown tongue with quick pulse, and typhoid symptoms. In fact, when death occurs from prostatic disease, it usually takes place in this way.

TREATMENT.—In the treatment of enlarged prostate little can be done by medical means; though the patient's condition may be somewhat ameliorated by treatment calculated to lessen irritation about the urinary organs, and to improve the condition of the urine. With this view, if it be very acid, alkalies with henbane should be given; if neutral or alkaline, the dilute nitric acid with henbane or opium; if mixed with ropy mucus or muco-pus, the infusion of buchu, or the balsams of copaiba, Peru, or turpentine should be administered. If hemorrhage occur, tincture of sesquichloride of iron,

infusion of uva ursi, or gallic acid, application of iodine, and other means of the enlarged gland, will be found a serious annoyance to the patient.

In the treatment of enlarged prostate catheter regularly, in order to empty of the bladder behind the prostate; at urethra, tends to collect an accumulation which the patient cannot expel with the impaired. The removal of these masses, independently of any retention, they may, to typhoid infection. The bladder is twice every day. This may best be catheter of full size, which should be patient should be taught to do himself the bladder, or retention in it of a quantity all the accompanying constitutional order to reach and empty the bladder be used. This instrument should be equal to about No. 12. In order to be carried away from the surface by the catheter be about four inches longer than an ordinary catheter. The viscus is usually pushed up high upwards of the lateral lobes, the curve and longer than usual. I find the best curve of which is exactly the third and-a-half inches in diameter. The catheter I have found it of use to have the lower piston-plate, so that, by withdrawing through the eyes of the instrument.



Fig 474.—Enlarged Middle Lobe of Prostate

curved gland the bladder nor one of these. It be taken a portion of well between against the do not swell middle lobe and valve not necessitate the introduction of pushes it certain the body of the correct often close or pouch, containing perhaps half as much as the pouch the catheter may enter and empty, supposing that he has passed the prostate content; but this is a grievous error, and the pouch.

TREATMENT OF RETENTION OF URINE.—When retention has occurred, relief can only be afforded by the proper use of the catheter, and this should never be delayed, as typhoid symptoms in elderly people rapidly set in. Three questions present themselves in connection with the treatment of this form of retention.

1. As to the *kind of catheter* that should be used, Sir B. Brodie recommends a gum-elastic instrument, long, of large size, and kept on a well-curved iron stylet, so as to preserve its curve when that is withdrawn. This must be introduced either with or without the stylet; if possible, without it. Other surgeons of great authority in these matters prefer the silver prostatic catheter; and I certainly think that *for the relief of retention* a silver instrument is safer, and more easily managed, than the gum-elastic one. It might be supposed that a less chance of mischief would result from the gum-elastic than from the metallic catheter, as being the softer and more yielding instrument; but this is, I think, erroneous, if the stylet be allowed to remain in, as it is then as rigid at the point, as hard, and as likely to penetrate soft structures as a silver one would be. If the stylet be withdrawn, it is often a very unmanageable instrument; it is impossible to know how to direct its point; and if the obstacle be difficult to surmount, it is not easy to guide the instrument over it. With the metallic catheter, on the other hand, the surgeon can feel his way as it were, and will, if he depress the handle well, as soon as the point enters the prostatic portion of the urethra, find little difficulty in guiding it into the bladder. It is the first introduction of the instrument that especially requires care, and as much gentleness as possible; after it has once been introduced, it will almost invariably readily find its own way.

It is a question whether the patient should be placed in the erect or in the recumbent position, when the catheter is introduced for the relief of urinary retention. I certainly think that the recumbent is not only the easiest position in which to introduce the instrument, but the safest. In old and feeble subjects the sudden withdrawal of the urine, by removing compression from the abdominal veins, and allowing these vessels to re-fill, may induce syncope, which occurring in the erect position might prove fatal. I have heard of one case in which the sudden death of the aged patient under such circumstances was attributed to this cause.

2. The next question in connection with the relief of retention in these cases is, whether the catheter should be *left in the bladder*, or be *withdrawn* after the viscus is emptied. As a general rule, it is certainly far better not to leave the catheter in; its presence in the diseased bladder setting up a low form of inflammation, or giving rise to sloughing of the mucous membrane. The instrument should be introduced twice in the twenty-four hours; and care should be taken, if possible, to empty the pouch behind the prostate by depressing its point. When the instrument is used habitually in this way, the gum-catheter may be employed. Should the mucus be very viscid and offensive, the bladder may be washed out with tepid water through a double current catheter. After the bladder has been emptied for the first time, it will be found to refill in the course of a very few hours, usually in six or eight, the secretion of the kidneys appearing to be set free on the removal of the pressure.

Should any great difficulty be experienced in introducing the catheter, it may be thought desirable to leave it in the bladder for two or three days; and then a gum elastic one is always to be preferred, as under these circumstances it presents a great advantage over the silver catheter, becoming soft, accommodating itself to the shape of the parts after the stylet has been

taken out, and not being so liable to irritate the mucous membrane at point, which, dipping down into the pouch behind the prostate, no syphon, emptying this part of the bladder far better than a silver could do.

3. The third question in connection with the relief of retention enlarged prostate, is as to the course that should be pursued if no instrument can be introduced into the bladder in the ordinary way. In those cases, which, however, very rarely occur, three lines of practice may be adopted: puncture of the bladder above the pubes, puncture above the rectum, or catheterism.

Puncture above the Pubes can very seldom be required. Since the University College Hospital was opened, only three cases have presented themselves in which it was thought proper to adopt such a procedure in retention from enlarged prostate; and in one of these cases, which was under my care, the enlargement of the prostate was complicated with a permeable stricture, which was, indeed, the main cause of the retention. The operation consists either in pushing the trochar at once through the abdominal wall; or else, as in tapping for ascites, making a small incision about half an inch in length through the integuments, exactly on the mesial line, immediately above the pubes, and then passing a trochar, with its concavity downwards and backwards, into the

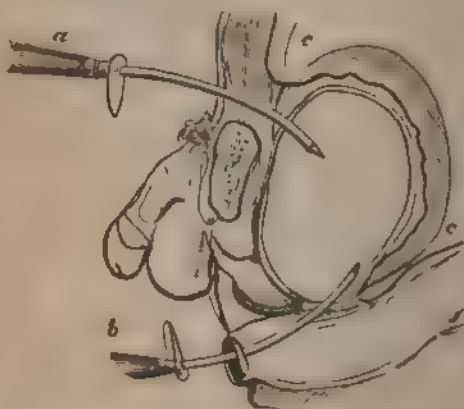


Fig 475.—a. Puncture above Pubes. b. Puncture through Rectum. c. Reflections of Peritoneum.

bladder behind that bone, and subsequently underneath the reflection of the peritoneum (Fig 475, a). After the bladder has been emptied, a cannula or an elastic tube must be left in situ to escape of the urine, the continuity of the passage is being restored. When the bladder is distended, in consequence of retention from enlargement of the prostate or any other cause, the peritoneum is carried up, and a considerable portion of the anterior wall of the organ uncovered by the peritoneum is left above the pubes. In a case of unrelieved retention from stricture, in which the patient died suddenly during the administration of chloroform, and which I had an opportunity of dissecting, I found the fundus of the bladder reached to five inches above the symphysis pubis, and was only two below the umbilicus; that the line of reflection of the peritoneum was $3\frac{1}{2}$ inches above the bone; and that the space covered by serous membrane was $2\frac{1}{2}$ inches wide. The bladder contained nearly forty ounces of urine, the retention having lasted during forty hours.

Puncture through the Rectum is not generally a safe procedure in retention from enlarged prostate, in consequence of this structure encroaching on a part of the inferior fundus of the bladder which is uncovered by peritoneum. When, however, the retention arises from enlargement of the upper portion rather than of the lateral lobes, this operation may be safely

and, indeed, I have known it put in practice with advantage in such cases (Fig. 475, b).

A safer procedure than this, and one that is recommended by Brodie, Liston, and most surgeons of authority in these matters, is *Forcible Catheterism*, or *Tunneling the Prostate*. As the retention is generally owing to an enlargement of the urethral portion of the prostate, relief may be afforded by pushing the point of a silver catheter through this obstacle into the bladder. A false passage is thus formed, in which the instrument should be left for about forty-eight hours, when it will generally enter it with sufficient readiness on being introduced again.

After the retention has been relieved, the bladder will often be paralysed for a time, the urine flowing out, but with no power of expulsion, for some weeks. In these circumstances the catheter should be used twice in the twenty-four hours; good diet, with wine, quinine, and extract of nux vomica may be given, and blisters applied to the sacrum; afterwards the patient should be taught to pass the catheter for himself once or twice daily.

The radical cure of the impediment to the flow of the urine has been proposed to be effected by removing the enlarged middle lobe of the prostate by ligature, by excision with a lithotrite, or by lateral or median incision of the perineum. Such operations, however, from their difficulty and danger, should not be lightly undertaken; perhaps the least dangerous mode of removal would be by median urethrotomy.

MALIGNANT DISEASE OF THE PROSTATE is of very rare occurrence. Its presence may commonly be ascertained by exploration through the rectum and urethra. The passage, also, of bloody urine, or of clear urine followed by a discharge of blood, mixed, perhaps, with the débris of a cancerous growth, will likewise tend to establish the nature of the affection, which is necessarily fatal.

PROSTATIC CALCULI have been already described in the chapter on Urinary Calculus (p. 1128.)

PROSTATORRHOEA.

Prostatorrhœa has been described by Dr. Gross as a discharge of clear glairy mucus from the prostate, in consequence of irritation of that organ. The disease is characterised by the discharge of a few drops of ropy, viscid mucus from the urethra after micturition or defæcation. It is chiefly of importance from its liability to be confounded with spermatorrhœa, and from the depressing effect consequently produced upon the patient's mind.

The *Diagnosis* of prostatorrhœa from spermatorrhœa may be effected by microscopical examination of the characters of the discharge.

The *Treatment* consists in attention to the state of the general health; the administration of tonics, more especially of iron and nux vomica; the removal of any local source of irritation in the urethra, rectum, or anus, as stricture, piles, or fissure; and the local application to the prostatic portion of the urethra of the nitrate of silver. The application of a blister to the perineum is beneficial in some cases.

CHAPTER LXIX.

DISEASES OF THE URETHRA.

URETHRITIS.

Simple Inflammation of the Urethra is especially apt to occur in strumous, rheumatic, or gouty individuals, from slight sources of irritation, either direct or sympathetic, that would not excite it in more healthy constitutions. In strumous children, it may arise from worms in the intestines, or from gastric irritation, and in gouty or rheumatic subjects, it appears to occur in connection with an acid or loaded state of the urine. In other cases, the irritation of a stricture, the passage of instruments, or of urinary sexual intercourse, may occasion the disease, without there being anything of a specific or venereal character about it. Contact with women who are out of health, pregnant, or suffering from leucorrhœa, may also often does give rise to local irritation of this kind. Urethritis, especially when arising from sexual intercourse, is frequently mistaken for gonorrhœa, but from this it may be distinguished by the less intense degree of inflammation, and by the absence of the secondary consequences that frequently follow true gonorrhœa; yet, in many instances, the diagnosis is extremely difficult, especially from the subacute forms of gonorrhœa that are prevalent in London.

SYMPTOMS.—Urethritis is characterised by heat, pricking, and tenderness about the urethra for a day or two, followed by mucopurulent discharges, often rather profuse, and accompanied by some ardor urinae. The symptoms altogether are not severe, and the disease usually subsides at the end of a week or ten days; but sometimes it becomes chronic, especially if conjoined with stricture, and then constitutes an extremely troublesome affection, more particularly in gouty individuals.

TREATMENT.—The treatment of urethritis is mildly antiphlogistic. The bowels should be kept open, and salines freely administered; in chronic cases small doses of colchicum, in combination with alkalies, will be found of especial service in cutting the disease short. The use of emollient and slightly astringent injections, such as opiate lotions, or a very weak solution of acetate of lead, with belladonna, will be found serviceable as the disease is on the decline, but not until then; and when the affection has reached the chronic stage, small doses of copoba may be advantageously administered. The diet in all cases should be of the blandest character, stimulants of all kinds being interdicted.

If the disease be conjoined with slight stricture, it may not unfrequently give rise to temporary retention of urine. This may, however, be commonly be readily relieved by antiphlogistic treatment, cupping, or leeches to the perineum, the warm hip-bath, and salines, with, perhaps, opiate suppositories, and plenty of demulcent drinks. The catheter should not be used in these cases, if it be possible to give relief without it.

URETHRAL ABSCESS occasionally forms as the result of urethritis, a soft fluctuating point being perceived in the neighbourhood of the canal. As soon as this is detected, it should be opened, when the aperture that results will readily close. If left, it will probably not burst externally, but into the urethra, the tissues in this direction being less resistant, and thereby

if it should be opened externally as well, a troublesome urinary fistula will result.

PERINEAL ABSCESS may form as the result of stricture or of urethritis, in whatever way excited; the patient complaining of a sensation of weight, with pain and throbbing, deep in the perineum. On examination, a hard tense swelling will be found, situated a little anteriorly to the anus, and extending along the side of the urethra. It presents no sign of fluctuation until it comes forwards into the scrotum.

The *Treatment* consists in the application of leeches, followed by fomentations, and an early incision through the perineum into the swelling. In some cases, the abscess is situated altogether externally to the urethra, and then the aperture closes readily enough, like that of any other ordinary abscess. In other cases, it communicates with the canal, and then fistulous openings are left, through which a certain quantity of urine escapes. These apertures gradually tend to close if they be not complicated with stricture or other urethral disease; should they be so, they will require special treatment, of a kind that will be described at p. 1186.

GONORRHOEA.

Gonorrhœa is a specific disease, accompanied by inflammation and an abundant muco-purulent discharge; affecting the urethra most commonly, but also the other mucous membranes of the genital organs, as of the prepuce and the glans in the male, and of the vulva and vagina in the female.

The urethra is the usual seat of gonorrhœa in the male; and the disease may be looked on as a specific urethritis, which is usually fixed with greatest intensity in the fossa navicularis; but it may extend itself over a much greater surface, affecting the entire length of the canal, and even the whole mucous lining of the bladder. In the female it commonly spreads over the extensive mucous surface of the internal organs of generation, and sometimes even invades the uterus.

CAUSE.—Gonorrhœa is a truly specific and a highly contagious affection, arising in all cases from the application of a peculiar animal poison, generated by impure or indiscriminate sexual intercourse, to the parts which it attacks, and must not be confounded with the various non-specific inflammatory diseases that may affect the parts commonly the seat of gonorrhœa, and which are all characterised by muco-purulent discharges.

The poison of gonorrhœa differs entirely from that of syphilis, as has been fully proved by the unerring test of inoculation; these diseases not being capable of reproducing one another under any circumstances.

CHARACTER.—Gonorrhœa is usually looked upon as a purely local affection of the genital organs. Some surgeons, however, amongst whom may be especially mentioned Travers, seem to consider it as occasionally assuming a constitutional character; in this opinion I entirely agree. Although gonorrhœa in the early stages is doubtless a strictly local affection, yet it is occasionally followed by a particular train of very characteristic phenomena, that can scarcely be looked upon in any other light than as the result of constitutional infection; the more so, as some individuals never have gonorrhœa without the disease being followed by these sequences, whilst others are altogether exempt from them. The parts that are secondarily affected are chiefly the fibrous tissues, the mucous and the cutaneous surfaces. The affections of the *fibrous tissues* give rise to rheumatism, and to peculiar forms of inflammation of the testicle and of the sclerotic. The affection of the *mucous membrane* displays itself in specific inflammations of the throat, and of the eyes; and the *skin* becomes the seat of certain eruptions.

The occurrence of these various affections, assuming as they do a type so distinctly marked that they can at once be characterized gonorrhoeal, certainly tends to show that the disease impresses the constitution in some peculiar manner, somewhat analogous to syphilis, though in a far minor degree, and with much less certainty, than the disease.

SYMPTOMS.—The symptoms of gonorrhoea in the male may be divided into three stages:—1. The Incubative Stage, or the period of Irritation; 2. The Acute Stage; and, 3. The Chronic Stage.

1. *Incubative Stage.*—The first stage, that of irritation, usually comes from three to five days after connection, when the patient begins to experience some degree of heat, itching, and general irritation about the penis. The lips of the urethra are somewhat red and swollen; its orifice is inflamed, and on squeezing it some muco-pus exudes. This stage usually commences about the time mentioned, but sometimes sets in immediately after connection; in other instances it does not occur for eight or ten days. Lasting for twenty-four or forty-eight hours it terminates in the second stage, which is one of active inflammation.

2. *Acute or Inflammatory Stage.*—The discharge now becomes abundant, thick, and of a greenish-yellow colour; there is great pain in passing urine, with considerable heat and smarting, and the urine flows in a diminished stream, but is passed with increased frequency. The urethra is now firm, and cord-like to the touch; the whole penis, indeed, looks greenish-red and turgid. As the disease advances, and the bulbous part of the urethra becomes affected, tension in the perineum will be complained of. If the prostatic portion be the seat of disease, there will be heat and swelling about the anus. During the whole of this period there is generally a great deal of constitutional disturbance, restlessness, and fever.

One of the most troublesome symptoms in this stage of the complaint is the occurrence of *Chordee*, which consists in painful erections at night, and a twist in the body of the penis, which is usually curved down towards the scrotum.

3. *Chronic Stage.*—These symptoms usually continue for about a fortnight when the third stage, that of subacute or chronic inflammation, sets in. During this period of the affection the inflammatory symptoms gradually subside, but a thin muco-purulent discharge keeps up, with some nocturnal heat and irritation about the urethra, and occasional smarting in passing water. Under proper treatment, this usually subsides in the course of another fortnight or three weeks; but, if neglected, or in certain constitutional conditions, it may last for many months, or even years, then degenerating into *Gleet*. In proportion to the continuance of the affection the inflammatory symptoms subside, though the specific and contagious character does not disappear, and the infection may continue so long as the discharge keeps up. Hunter mentions the case of a girl who had been two years in the Marine Hospital, and who infected a person with whom she had connection immediately after she left that Institution. The persistence of the contagious gleet is, it is true, more marked in women than in men. So long, however, as any discharge continues from the male urethra, the patient must be looked upon as infectious.

The severity and the continuance of gonorrhoea are often opposed to each other. Thus the disease is most severe in young and plethoric persons, and in first attacks; but it is most difficult of cure in strumous and phlegmatic constitutions, more especially if there be a gouty or rheumatic tendency co-existing, and is very troublesome to remove after repeated

attacks. I have observed repeatedly that it is very apt to degenerate into a gleet in people who are subject to chronic diseases of the skin.

The length of time that the infection of gleet will continue in both sexes, but especially in the female, makes it somewhat difficult to say whether the poison of gonorrhœa can be generated *de novo*, as it is not improbable that many individuals communicate the disease, believing themselves to be perfectly cured, though still suffering from slight gleet.

TREATMENT—The treatment of gonorrhœa must be conducted with reference to the stage to which the disease has attained, but especially with regard to the amount of inflammatory action accompanying it. It is of two kinds, *rational*, and *specific* or *empirical*. Both plans are useful, and, indeed, usually necessary for a proper cure, but they cannot be adopted indiscriminately. Thus, if specific means be employed during the acute inflammatory stage of the complaint, much mischief may ensue; whilst, if antiphlogistic treatment be persevered in for too long a time, the disease may be kept up indefinitely.

It has been proposed to adopt what has been termed the *abortive* or *revulsive* treatment, during the earliest stages of gonorrhœa; indeed, during the *incubative* period. This method consists either in the injection of a very strong solution of the nitrate of silver into the urethra, or in the application to the inflamed mucous membrane of a strong ointment of that salt by means of a bougie smeared with it; other surgeons, again, have recommended the administration of very large doses of copaiba at this period. These various plans, have, however, I think, deservedly fallen into disrepute. I have on several occasions seen most intense inflammation produced by this mode of treatment, and never, in any case, any good result. Independently of this, it is impossible to know whether the case, in the earliest stage, will prove to be one of simple urethritis or a specific gonorrhœa.

In the *acute inflammatory stage*, attended by heat, swelling of the organ, great ardor urinae, and abundant muco-purulent discharge, the treatment must be entirely antiphlogistic, the activity of the measures being proportioned to the intensity of the inflammation. If this be very severe, leeches may be applied to the perineum, or to any very tender point along the urethra. If it be not so intense, warm hip-baths, poppy fomentations, or the envelopment of the penis in warm-water dressing, will be of essential service. At the same time the urine must be diluted, and its acidity lessened, by the patient drinking large quantities of alkaline diluents,—barley-water or linseed tea containing a little nitre or carbonate of potash in solution, or soda-water; and the skin and bowels may be kept in action by the administration, every fourth or sixth hour, of a powder composed of a drachm of sulphate of magnesia, 5 grains of nitre, and $\frac{1}{12}$ th of a grain of tartar emetic, dissolved in a wine-glass of water. All stimulants must be avoided, the diet being restricted to light slops, and perfect rest enjoined. By such means as these, the activity of the inflammation will be gradually lessened, the discharge becoming thinner, the smarting in micturition not so severe, and the erections less painful. The patient should also be desired to pass his urine frequently, so that it may not be too concentrated.

When the *third stage* of the disease has been reached, specific treatment may be employed with great advantage; while, if recourse were had to it at an earlier period, it would certainly increase the inflammatory action and give the patient much distress. Even in this stage the specific remedies, such as copaiba and cubebæ, must be cautiously given; the surgeon feeling his way with them, and being prepared to discontinue them and to return to strictly antiphlogistic measures, if he find that they increase the irritation.

Should the disease, however, from the commencement, have assumed subacute character, the specific treatment may with safety be adopted at much earlier period.

Copaiba and cubebs are the remedies that are almost universally used at this stage of gonorrhoea. Of these copaiba is the least irritating, and consequently most generally to be preferred. It may be administered in a variety of ways; in capsule, pill, draught, or extract. The capsule is generally to be preferred, on account of the nauseous taste being thereby readily disguised; but in many cases it acts with more certainty, and to better effect, if given in either of the other forms. When the capsules are given, the patient may take from six to eight or ten in the day, and at the same time have an alkaline mixture, which increases the medicinal effect of the drug. A very excellent mode of administering copaiba is to rub it down into a mass with burnt magueesia, and to let the patient swallow about a drachm of this paste three times a day, in a bolus wrapped in paper; or, if the taste be not much objected to, he may take it most advantageously in mucilage, with liquor potassae and tincture of henbane.

In some relaxed constitutions, and more particularly after frequent use of cubebs will be found to cure the patient more readily than copaiba, and most successfully if given in combination with it. An excellent preparation is to put about half an ounce of powdered cubebs into a mortar, and to mix it up with as much copaiba as will form a stiff paste, of which the patient should take a drachm as a bolus thrice daily. The effects of this preparation are often most striking; but it can only be used in the milder cases, as indicated, and after the more active inflammatory symptoms have subsided.

It is during the third stage of gonorrhoea that *injections* may advantageously be used. Much and very unfounded prejudice exists against their use in the minds of many; but surely it is as safe to apply proper local applications to an inflamed urethra as it is to an inflamed conjunctiva. The bad consequences, such as stricture and inflamed testicle, which have sometimes been referred to their use, have either been due rather to long continuance and to the severity of the disease itself than to the remedies employed, or to their application at too early a stage or of too great strength. It is in long-standing cases of gonorrhoea, in which the disease continues for months or years, that stricture results, not in cases of short duration; and in these it is the result of the chronic inflammation, thickening of the mucous membrane, and has no more to do with injections than with the copaiba or salves the patient may have taken. When the ardor urinae subsides, emollient and slightly astringent injections may be used. The best is perhaps the acetate of lead in tepid water, of the strength of two grains to the ounce. If this induce irritation, a few grains of watery extract of opium may advantageously be added. As the disease subsides, a stronger astringent is required, and then one or two grains of the acetate of zinc may be added to each ounce of the injection; or a very weak solution of sulphate or chloride of zinc may be employed, gr. ij of the first, and gr. iij of the second, to each ounce of water; or an injection of gr. ʒ of the muriatic acid to the ounce may be used. During the whole of this stage, the diet and habits of life must be carefully regulated, and all stimulants interdicted. The injections should be discontinued as soon as the discharge has completely ceased, unless this be done, they may re-induce it.

The mode of injection is of importance. A glass syringe should always be used, with a smooth rounded nozzle. The patient, sitting on the edge of the chair and holding up the penis, should carefully insert the end of the syringe between the lips of the urethra, and then slowly squeeze in the in-

tion as far as it will go. Although the inflammation is usually confined to the anterior portion of the urethra, yet it may extend to the bulb, and the injection should be applied to the whole length of the inflamed mucous membrane. If any enter the bladder it cannot signify, as it will immediately be decomposed by the salts and mucus of the urine.

In *gleet*, much difficulty will often be experienced in curing the patient of his discharge. Here much depends not only on the administration of proper remedies, but in care being taken attentively to regulate his habits of life. It will constantly be found that, after the disease has apparently been cured, excesses at table, and more especially the drinking of beer, or of effervescing or acid wines, will bring back the discharge. It will also return after connection, though it have previously ceased entirely. This is especially the case in strumous, gouty, or rheumatic constitutions, in which all urethral inflammations are with difficulty removed. In these cases, then, abstinence from all stimulants, dietetic as well as alcoholic, and improvement of the tone of the system by change of air, sea-bathing, &c., will often be of essential service. At the same time, the electuary of cubebs and coraiba, or one composed of cubebs and the sesquioxide of iron, may be administered with advantage. In other cases, especially in relaxed constitutions, tincture of sesquichloride of iron, alone or conjoined with a few drops of spirits of turpentine or tincture of cantharides, will produce much advantage.

In chronic *gleet*, local applications will be found to be necessary for the cure of the disease. Amongst these I have found none more useful than one composed of ten grains of chloride of zinc and one scruple of gallic acid to eight ounces of water. In some cases, injections of nitrate of silver, of the strength of half a grain, or of bichloride of mercury, in the proportion of a quarter of a grain to the ounce, will be serviceable. And, indeed, in most instances it is beneficial to vary the injections; the mucous membrane appearing to become accustomed to the same stimulant after a time, and thus not being impressed by it in a proper manner.

After the *gleet* has continued for some months, more benefit will often be derived from the introduction of a full-sized metallic bougie every second or third day than from any other local means, even where no stricture exists. The instrument should be left in for about ten minutes, and should be of the largest size that the urethra will admit.

COMPLICATIONS OF GONORRHOEA.—Gonorrhœa, when acute or virulent, seldom runs its course without local complications of some kind, the result of the propagation of the inflammation to neighbouring parts, often of considerable severity, and occasionally even hazardous to life;—such as chordee, phimosis, sympathetic bubo, perineal abscess, irritability of the bladder, retention of urine, hemorrhage from the urethra, &c. Many of these complications present no special features, but require to be treated on general principles, without reference to their specific cause. Others demand more special management, and these we may briefly consider here.

Chordee, or painful erection of the penis, with twist of the organ, coming on at night, is often a most distressing and troublesome symptom. It is usually best relieved by the application of cold to the part, but more especially by the administration at bed-time of a pill composed of gr. j of opium with gr. v of camphor, the camphor acting as a direct sedative to the generative organs. Ricord recommends a suppository of camphor and opium, gr. x of camphor, and gr. j of the watery extract of opium, to be introduced into the rectum an hour before bed-time, as the best means of removing the tendency to chordee.

Irritability of the Bladder with Spasms of the Neck, Strangury, and Dysuria,

may be of two kinds; either *inflammatory*, coming on in the earlier stages of the disease with pain in the perineum, and all the symptoms of acute inflammation about the part strongly marked; or *atonic*, supervening at a more advanced period, without any special signs of inflammation. In the first case, leeches to the perineum, hot poppy fomentations, the warm bath, with full doses of Dover's powder, or of henbane and carbonate of potash or nitre, will probably afford much relief. When the disease is atonic, the administration of tincture of sesquichloride of iron, conjoined with local soothing remedies, as the poppy fomentations or bulet, and an opiate suppository, will be beneficial.

Retention of Urine from Gonorrhoea.—The obstruction is usually dependent on congestion and inflammation of the mucous membrane of the urethra. Leeches to the perineum, the warm hip bath, and opiate suppositories will probably afford relief. It is always desirable to avoid using the catheter, as it is apt to lacerate the swollen and softened mucous membrane and thus to occasion troublesome bleeding; and will always produce much pain, and increased irritation of the canal. Should, however, the retention have continued twenty four hours, or longer, it may most probably not give way to the means above indicated, and then it will be necessary to use the instrument, when a full sized silver one should be very carefully introduced; a large instrument entering the bladder as easily as a smaller one, and with less risk of injury to the tender walls of the canal.

When the catheter has been introduced, it is often somewhat difficult to determine whether it should be left in or taken out. If it be left in, the inflammatory action is increased. If it be taken out, the surgeon may not be able to introduce it again. The solution to this question is to be found in the facility with which the instrument is passed. If it have been introduced without much difficulty, it is better to withdraw it after the bladder has been emptied, and to continue the antiphlogistic treatment, when a second introduction may not be required. If, on the other hand, the catheter have been passed with great difficulty, and be firmly grasped either by spasm or stricture, it should be left in; but very active treatment must be employed to prevent it from exciting too much inflammation.

It must, however, be remembered that the retention may be due to more serious conditions; to prostatitis, to abscess in the prostate or in the perineum, or to inflammatory exudation in the tissues about the neck of the bladder. In these circumstances, more active antiphlogistic measures will be required, with the use of the catheter twice in the twenty four hours, and probably free incisions into the perineum, if there be pus or urine extravasated into that region.

In many cases of gonorrhoeal retention, there is an old stricture as well as the clap. Here the employment of energetic antiphlogistic measures with the use of the catheter are indicated; but, as the stricture is the chief cause of obstruction, the treatment must be directed to it.

Hemorrhage from the Urethra may occur either as the result of chemical and consequent rupture of some blood-vessels of the mucous membrane, or the consequence of attempts at passing the catheter, or as a kind of exudation from the mucous membrane. Most commonly it may be arrested by the application of cold, and the employment of moderate local antiphlogistic treatment. Should it be abundant, pressure by means of a bandage to the penis or perineum, and the introduction of a large gum elastic catheter, will arrest it.

SEQUENCES OF GONORRHOEA.—The sequences, or more remote complications of gonorrhoea, are partly local and partly constitutional. Amongst the

local, we find more particularly *Warts* about the prepuce and glans or within the urethral orifice, which require to be treated by excision or caustics; and *Stricture*, the management of which is fully described elsewhere. In some cases, also, in consequence of extravasation of blood, or the effusion of plastic matter into the corpus spongiosum or the corpora cavernosa, limited and localised *Induration and Thickening of the Penis* may result, attended by chordee, painful erections, and a permanent twist in the organ. In such conditions as these, absorption of the effused mass may be attempted by the administration of small doses of bichloride of mercury, with theunction of iodide of lead ointment.

After the cure of a clap that has been of long continuance, the generative organs are often left in a *weak and irritable state*; the penis, scrotum, and spermatic cords being lax and elongated, with an apparent want of power, and often painful and dragging sensations about the cords and groins.

Besides the strictly local complications of gonorrhoea, a certain set of sequences to which some constitutions are especially liable, occasionally occurs as the result of this disease; viz., inflammation of the testes and of the eyes, rheumatism, cutaneous eruptions, and sore throat. Some of these, as the affections of the eyes and testes, may be either local or constitutional; the others are clearly constitutional.

Gonorrhoeal Inflammation of the Testis is certainly the most common of these sequences. It almost invariably affects only one testis, and commences in the epididymis, whence it extends to the body of the organ. It usually occurs in individuals who have a lax and long scrotum, with very pendulous testes. It seldom sets in before the third week after the occurrence of gonorrhoea, but may occur at any period during the continuance of the discharge, though it is more frequent between the fifth and sixth weeks than at any other time. In cases of gleet, also, it not uncommonly occurs at a later period. In many instances it is referred to some slight injury—a blow, or squeeze, received during the continuance of the gonorrhoea; but in other cases it would appear to arise from extension of the inflammation along the ejaculatory duct; and in others from a kind of metastasis of the morbid action from the urethra to the testis. That the disease commences in the epididymis, may be advanced in support of the first opinion; whilst the fact that the discharge usually ceases when the inflammation of the testicle comes on, and returns as it subsides, may be adduced in support of the doctrine of its metastatic origin. As the symptoms and treatment of gonorrhoeal inflammation of the testicle present nothing peculiar, I shall reserve their consideration until we speak of diseases of this organ.

Gonorrhoeal Inflammation of the Eyes is fortunately not of very common occurrence. It may affect either the conjunctiva or the scleroticæ.

Gonorrhoeal Conjunctivitis is one of the most destructive forms of ophthalmia, giving rise, not unfrequently in the course of forty-eight hours, to the most intense chemosis, with opacity and softening of the cornea, followed by staphyloma and a discharge of the humours. In the majority of instances only one eye is affected; but, in some, both are involved to an equal extent. The disease commences with the ordinary symptoms of conjunctival inflammation; itching and swelling of the eyelids, velvety redness of the conjunctiva, muco-purulent discharge, with much lachrymation. The chemosis sets in early, and is very severe; and, unless treatment afford speedy relief, the consequences are most disastrous to vision. Lawrence states that, of 14 cases that fell under his observation, 9 had only one eye affected and 5 both. Of the 9 in whom one eye only was diseased, the organ was lost in 6 cases, of the 5 in whom both eyes were affected, both organs were destroyed in

one case; in 2 one eye only was lost; one patient recovered imperfectly and in only one did complete recovery ensue.

It has been a question with surgeons, whether gonorrhoeal ophthalmia is the result of the direct application of the specific pus to the conjunctiva, or occurs as a constitutional disorder. There can be little doubt that the introduction of the pus to the surface of the conjunctiva might occasion the disease, but at the same time it is perfectly certain that in many instances there is no evidence of contact; the inflammation occurring in both eyes without patient having apparently communicated it; and, though it is somewhat difficult to adduce positive proof on this point, it is but reasonable to suppose that such cases may be constitutional.

The Treatment of this dangerous affection must be of an active nature. Blood should be taken freely from the temples by cupping, or, if the patient be sufficiently robust, from the arm, as strongly recommended by Lawrence, who places great reliance on it; he must of course be kept in a strict diet and on strict antiphlogistic regimen. The disease must, however, be treated, and the eye can alone be saved, by active local treatment. The most powerful topical agent that we possess is the nitrate of silver. The use of this as astringent, originally introduced by Latell, has been much imitated by Guthrie, Walker, and others, and is generally adopted at the present time, being certainly the most useful agent that we possess. Surgeons are somewhat in opinion as to the strength of the application, some of the Germans especially, advise that the solid stick should be used; whilst others employ it in solution, of the strength of a drachm to the ounce of distilled water. Wharton Jones employs a weaker solution, one of four or five grains to the ounce, and I have seen cases very successfully treated by this, so much so, indeed, that I am disposed to prefer it to the stronger solution. A few drops must be introduced about twice in the twenty-four hours, into the inner canthus of the eye; the lids in the meantime being kept open by compresses dipped in weak alum lotion, and the purulent discharge, if it accumulates, carefully washed away by tepid alum injections. In the use of this, great care must be taken that none of the discharge comes into contact with the eyes of the surgeon or nurses, as it is highly contagious, and almost to a certainty produce the disease; instances are recorded in which in this way, the attendant's vision has been destroyed. If the chemosis is considerable, it must be incised; and, as the inflammation subsides, the donna lotions may be employed with advantage, and the use of the nitrate of silver gradually discontinued.

Gonorrhoeal Scleritis is by no means of such frequent occurrence as conjunctival inflammation; when it happens, it will commonly be found to be associated with gonorrhoeal rheumatism, and not unfrequently with inflammation of the testicle, occurring apparently in individuals in whom there is a tendency to affection of the fibrous tissues. This disease is evidently of constitutional origin, as it cannot possibly arise from local contagion; it is attended by the ordinary signs of sclerotic inflammation, and is usually accompanied by some degree of iritis.

In the Treatment there is nothing very peculiar. Cupping or leeching the temples, with belladonna fomentations, are the principal local means, and calomel and opium, continued until the gums are affected, constitute the chief internal remedies; these means must be persevered in until the anterior chamber clears, and any effused lymph is absorbed. As the inflammation declines, and especially if the patient be somewhat debilitated, acids, rhubarb and bark in powder may be given internally, and blisters kept open on the temples.

Inflammation of the Nose, attended by profuse suppuration, is a complication that I have more than once had occasion to observe in gonorrhoea. The swelling of the organ is considerable, the tenderness great, and the discharge abundant; a condition, indeed, of the Schneiderian membrane that seems analogous to the inflammation of the conjunctiva just described.

The *Treatment* that I have found to succeed best, consists in fomentations followed by astringent lotions or injections.

Gonorrhoeal Rheumatism principally occurs in young, florid, and otherwise healthy men. It is of two kinds; in one, the most common, and indeed the typical variety, the fibrous and muscular structures are affected; in the other, the joints are implicated. The fibrous or muscular form of rheumatism is not unfrequently associated with inflammation of the testicle or of the sclerotic. It commonly affects the fleshy parts of the body, as the hips, the shoulders, and the thighs, and not infrequently occurs in the soles of the feet. It is always painful at night, but is not commonly attended by any very severe constitutional disturbance. The synovial form presents the ordinary characters of rheumatism of the joints, the knees and ankles being those chiefly involved.

In the *Treatment* of these affections, calomel and opium, or Dover's powder with colchicum, must constitute the most important elements until the acute stage is passed, when iodide of potassium may be advantageously given.

Cutaneous Eruptions, chiefly consisting of roseola, with slight pityriasis, and perhaps a few patches of psoriasis with very flimsy scales, occasionally occur in rather severe cases of gonorrhoea, usually appearing from six weeks to three months after the commencement of the attack. They are chiefly diffused about the chest and belly, and present no sign of coppery redness. At the time of their occurrence, the fauces commonly become similarly involved, presenting, as was first pointed out by Travers, a diffused superficial redness on the velum palati and pillars, with perhaps superficial ulceration on these, the tonsils, or the uvula. The occurrence of these affections is usually preceded by slight febrile action, which, however, subsides on their full evolution. The roseolar eruptions, occurring during gonorrhoea, have occasionally been attributed to some peculiar influence exercised by the copaiba, but I think not on sufficient evidence. I am not aware that copaiba, when administered for other diseases than gonorrhoea, ever produces such eruptions; and they will occur, as I have seen in several instances, when no copaiba is being given.

The *Treatment* of these affections should consist in the administration of salines, followed by iodide of potassium in small doses. Mercurials are never required.

GONORRHOEA IN THE FEMALE differs from the same affection in the male in not being so severe, though it is usually more extensive, and of longer duration. The severity is less, on account of the shortness of the female urethra preventing the occurrence of the retention of urine as in the male, and also from the absence of such parts as the prostate, testes, &c., the implication of which constitutes the principal source of difficulty in men. Gonorrhoea in the female may affect the part to very different degrees; thus the vulva alone may be implicated, or, as most commonly happens, the inflammation may spread to the whole of the mucous membrane of the vagina. The urethra is less commonly the seat of disease, though occasionally implicated with other parts; and, lastly, the interior of the uterus may become affected by this specific inflammation. In some cases, it will even spread along the Fallopian tubes to the ovaries; and I have known one or two cases in which rather acute

attacks of peritonitis, probably induced in this way, have complicated disease.

The *Symptoms* of gonorrhœa in women are sufficiently well marked in early stages, when there is an abundant muco-purulent discharge from parts affected, with a good deal of inflammatory irritation, accompanied by pain in micturition, and a frequent desire to pass urine. As the disease becomes chronic, however, it is more difficult to determine its true character, it being apt to be confounded with some of those accidental and leucorrhœal discharges to which females of all ages are subject.

Diagnosis.—In the majority of cases, gonorrhœa may be distinguished from all other muco-purulent discharges of the female organs, by the presence of inflammation about the external parts, and the mucous membrane of the vagina and urethra. In these cases it will be found, on introducing a speculum (which, however, occasions considerable pain, and is firmly grasped by contraction of the vagina), that the discharge comes from the vagina, and that the uterine orifice is free from it, or nearly so; whereas in leucorrhœa the discharge proceeds in a great measure from the interior of the uterus, the os and cervix of which will probably also present signs of inflammation. It must, however, be borne in mind that the discharge in gonorrhœa may occasionally be in a great degree uterine; and that that of leucorrhœa may be an exudation from the mucous membrane of the vagina. In such circumstances, when the disease is chronic, it is almost impossible to arrive at a correct conclusion as to the nature of the case from simple inspection; and in these cases of doubt the surgeon had better give a guarded opinion, lest he be led into the error of inculpating an innocent woman. The difficulty is increased, and a good deal of obscurity thrown over the case, by the fact that leucorrhœal discharges will occasionally give rise to urethritis in the male, which closely simulates gonorrhœa. Girls also are occasionally subject to an acute inflammation of the vagina, nymphæ as the result of simple irritation, of constitutional disturbance, or teething; these cases require to be recognised, as they have frequently been the cause of unfounded accusations.

The *Treatment* of gonorrhœa in the female must vary, according as the disease is acute or chronic. In the acute stage, general and local antiphlogistic means—salines, low diet, rest in bed, and emollient sedative fomentations—must be used. As the disease subsides into a chronic one, the astringent injections must be employed; a weak solution of acetate of lead, or the liquor aluminis composuit largely diluted with tepid water, being especially useful. In other cases, a weak solution of nitrate of silver may be used with much advantage. These injections should be employed three or four times a day, and in large quantity. As they have been thrown up, a piece of lint well soaked in the lotion should be introduced between the opposed mucous surfaces, so as to prevent their coming into apposition, the discharge being in a great measure kept up by their friction against one another. In order that the injection may be properly given, the woman should lie flat on her back, and pump in the fluid by means of one of Kennedy's elastic bottles. In the treatment of gonorrhœa in women, specifics are of no use unless the urethra be affected, when mercury may be given, as in the male. The disease is apt to degenerate into a chronic gleet condition, leaving a thin muco-puriform discharge, which will continue to be infectious for a great length of time.

STRICTURE OF THE URETHRA.

Much discrepancy of opinion has for a long time existed as to the structure of the urethra, some surgeons admitting, others denying its muscularity. Though the presence of muscular fibres in the urethra had been suspected by many in consequence of the phenomena presented by some forms of stricture being solely explicable in this way, it is only in recent times that their existence has been demonstrated; Kolliker and Hancock having shown that the tube is surrounded through its entire length with an organic muscular coat. Hancock has demonstrated the course of these fibres. He has pointed out that the fibres of the inner layer of the muscular coat of the bladder pass forwards underneath the mucous membrane of the prostatic portion of the urethra, and those from the outer layer of the muscular coat of the bladder outside the prostate. These two layers join at the membranous portion of the urethra, forming the muscular covering of this portion of the canal. At the bulb these two layers divide again; the inner lying underneath the mucous membrane, separated from it merely by cellular tissue; the external lying outside the corpus spongiosum, between it and its fibrous investment. At the anterior extremity of the urethra they unite again and form its lips. Thus the urethra is surrounded through its whole length by muscular fibres, a double layer of which invests it at the membranous portion, and again at the external meatus. The prostate and corpus spongiosum are included between planes of these fibres. The vesicles and ducts of the prostate are surrounded by layers of organic fibre; those of the ejaculatory ducts coming from the organic layer of the vas deferens. These fibres are totally distinct from the common muscular apparatus of the perineum; and their existence proves the urethra to be, as had often been suspected, a musculo-membranous canal.

By *Structure of the Urethra* is meant a narrowing of the canal at one or more points. These may proceed from three distinct conditions; viz.—1, Spasmodic Action of the layer of the organic Muscular Fibres situated outside the mucous membrane; 2, Congestion of the Mucous Membrane of the canal; or, 3, Organic Changes in the Mucous and Submucous Tissues, consisting of thickening, induration, or the deposit of plastic matter within them. According as the disease arises from one or other of these causes, it may be termed a *Spasmodic*, a *Congestive*, or an *Organic* stricture. These different forms of the disease having the one condition—narrowing of the urethra—and its consequences, in common and in practice, being often associated together, present so much variety in their symptoms, in the treatment they require, and in the constitutions in which they occur, as to require separate description.

SPASMODIC STRICTURE.—The existence of this form of the disease has been much cavilled at. Surgeons, disregarding the evidence of their own senses, and being led away by an imperfect anatomical examination of the urethra, have denied the possibility of spasm of this canal, not being able to demonstrate the existence of any muscular fibres in sufficiently close proximity to the mucous membrane to influence it by their action. The possession of muscular contractility by the urethra is, however, obvious from the facts that a bougie may occasionally be introduced with sufficient ease, but that the surgeon, on attempting to withdraw it, will find it tightly grasped: so also occasionally, on introducing the instrument, he will feel it meet with an obstruction, which on steady pressure will yield with that species of quivering that is peculiar to spasm of muscular fibre. Again, the fact that a patient will at one time pass his urine with the most perfect freedom, whilst,

if it be rendered acrid or acid by drinking spirits, other potent wines, other similar beverages, almost complete obstruction will ensue, and will prove the existence of an occasional spasmodic constriction of the urethra. These facts, though sufficiently convincing to many surgeons, had not carried proof of the existence of spasmodic stricture to others, until the researches of Kolliker and Hancock, which have already been referred to, the question of the muscularity of the urethra finally at rest.

Causes.—The causes of spasmodic stricture are generally such as to occasion a relaxed and irritable state of system, as long residence in warm climates, especially if conjoined with habitual excesses in drinking, eating, living, and venereal indulgences. The more immediate causes are any circumstances that occasion irritation of the urethral mucous membrane, which, being propagated to the organic muscular fibres beneath, call them into activity and thus gives rise to the spasmodic affection. The nature of these are those conditions of the system in which the lithates are not eliminated; as exposure to cold and wet, by which the action of the system is suspended; or too free an indulgence in spirituous and acid liquors—as red or effervescent wines, beer, or punch—which are well known to give rise to an attack in many constitutions.

Symptoms.—In spasmodic stricture we find evidence of narrowness of the urethra, and consequent impediment to the free flow of urine, varying under the influence of certain causes, and as speedily subsiding in a patient, for instance, in his ordinary health and passing urine freely, he take such food or drink as will give rise to a very acrid condition of fluid, if he be exposed to cold, or get out of health in any way, and finds himself able only to pass his urine in a small stream by drops with straining, or may even be seized with complete retention. Under appropriate treatment these symptoms rapidly subside; recurring, however, on application of any exciting cause. At the time of the occurrence of a spasm there is often a sensation of weight and uneasiness in the penis with evident irritation of the urethral mucous membrane, as shown by reddening of the lips of the orifice: in fact, a tendency to a combination of congestive with the spasmodic form of stricture. There will often be found to be a very slight organic stricture in cases of the spasmodic form of disease; so that, when the spasm subsides, the urethra will not be so free as natural.

Treatment.—If the patient be suffering from spasmodic difficulty in passing urine, a suppository, consisting of a drachm of laudanum in a little oil, should be thrown up the rectum, the warm hip bath used, and a few grains of Dover's powder administered. As the opium begins to take effect, the urine will usually be passed without much difficulty. The bougie should be made to act, when the patient will usually be relieved. If the spasm continue, as it often does, for some days or weeks after this, a fusiform bougie should be introduced every second or third day, in order to overcome the irritability of the urethra. In some cases this is more effectually done by the use of a plated bougie, well warmed and oiled. Whatever instrument used should be of large size, from No. 8 to 10. A small bougie will be arrested, and will create much irritation, when a large one will pass readily. If the use of the instrument cause irritation and increase of spasm, it is better to omit it entirely, and to trust to constitutional treatment. Let the surgeon must not be discouraged, if the first few introductions of the bougie appear to increase the irritation; as the urethra becomes accustomed to the use of the instrument, relaxation of the spasm will take place. At the same time the patient's general health should be carefully attended to, the bowels

must be kept open, and the diet regulated; all acids, stimulants, and sweets, being carefully avoided. During the time when the bougie is being used he should take, three times a day, a draught, composed of twenty minims of liquor potassæ, with the same quantity of tincture of henbane and sweet spirits of nitre, in camphor julep.

As a *precautious treatment* of these attacks, a careful regulation of the diet, warm clothing with the use of flannel, and keeping the skin in action by means of horsehair gloves and tepid baths, will be found serviceable.

CONGESTIVE STRICTURE.—Many surgeons look upon *spasmodic stricture* as essentially dependent on congestion of the mucous membrane of the urethra, overlooking altogether the existence of spasm, or considering it as the result of irritation of the perineal muscles, and not of the true organic muscles of the canal. That the two conditions of congestion and spasm are frequently associated in the urethra, in the relation of cause and effect, there can be no doubt; and this is the most frequent condition in which spasmodic strictures are found. Indeed, congestion plays an important part in all forms of stricture; it may, as we have just seen, be connected with the spasmodic variety; it may occur alone; or it may be associated with organic stricture. Some parts of the urethra appear to be more subject to congestion than others; thus, for instance, the membranous and prostatic portions, especially the folds of mucous membrane constituting the verumontanum, are peculiarly liable to become congested.

Causes.—Congestive stricture frequently occurs as the result of chronic and long-continued inflammation of the urethra, or of the passage of urine that has been rendered irritating by being too concentrated, or by an admixture of an undue proportion of lithates. It is especially in gouty or rheumatic subjects who suffer from irritability of the skin and mucous membranes that this condition occurs. In these cases there is no true or permanent obstruction, but the disease is transitory, and solely due to a swollen state of the membrane of the part.

Symptoms.—In congestive stricture we not only find the common symptoms occasioned by an impediment to the free passage of the urine, but some swelling of the lips of the urethra, with reddening and eversion of them. There is also slight gleet-like exudation, and not unfrequently an abundant puriform discharge, in fact, urethritis of a marked kind, with a sense of weight or fulness in the perineum, pain in micturition, and sometimes uneasiness in defecation. This state of things constitutes a very troublesome affection, intimately connected with the various forms of urethritis, and exceedingly apt to relapse from apparently very trivial circumstances, slight errors of diet, dyspeptic derangements, or any local sources of irritation.

The **Treatment** in these cases should consist in careful regulation of the diet and habits of life, and especially in the administration of the alkaline and sedative mixture above indicated in combination with small doses of copala. In many cases a course of Plummer's pill, in conjunction with compound decoction of aloes, will be found of essential service. If there be much tenderness or weight about the perineum, the application of leeches to this part, together with the use of the warm hip-bath, will be serviceable.

Congestive stricture, though more influenced by constitutional than by local means in many cases, yet requires the introduction of bougies in order to prevent the constriction from becoming permanent. In some instances a wax, in others a silver or pewter instrument, will be found to answer best. Whatever is used, care should be taken to introduce it slowly and with every possible gentleness. With all care, some hemorrhage usually follows the passage

of the instrument ; not from laceration, but simply as the result of excision of the mucous membrane ; and the discharge of blood appears rather to be beneficial than otherwise.

ORGANIC STRICTURE.—This form of stricture is the result either of continued inflammation of the urethra, leading to changes in the membrane, or of some injury to the canal from blows or laceration perineum, by which a portion of it is destroyed or sloughs away. Syphilis, gonorrhoea and long continued gleet are the most fertile causes of this disease. In the urethra as elsewhere, plastic matter is deposited and around the mucous membrane in the submucous cellular tissue as a result of inflammation ; consolidation of this takes place, followed by traction of the canal. The long continuance of inflammation is more dreaded than its intensity in occasioning this mischief, hence it is of importance not to allow gleet to run on indefinitely, as they are sure to a certainty be followed by constriction of some portion of the urethra.

Seat.—The seat of organic stricture varies considerably ; indeed, any part of the urethra may be affected by it, except the prostatic. It appears to be a common belief amongst surgeons, that the membranous portion of the urethra is the most frequently affected by this disease. This, however, there is little doubt, is an erroneous opinion. H. Smith has examined 98 specimens of stricture contained in the different London museums, of which he found only 21 seated in the membranous portion of the urethra, 77 were anterior to the triangular ligament ; the majority of these were either in the bulbous portion of the urethra, or a little in advance of it. H. Thompson, in his excellent work on *Stricture*, states as the result of his numerous observations, that stricture is more frequently met with at the junction of the spongy and membranous portions of the urethra, about one inch anterior to this ; and most rarely, so far back as the membranous portion itself ; lastly, he states, “ I can confidently assure that there is not a single case of stricture in the prostatic portion of the urethra to be found in any one of the public museums of London, Edinburgh or Paris.” Not unfrequently strictures are met with at the mouth of the urethra ; and occasionally they are multiple, two very frequently occurring and sometimes as many as four or five. When there are several strictures, one will always be found at the bulb or in the membranous portion of the urethra.

Characters.—The characters of organic stricture vary greatly. In some cases it is annular, encircling the whole of the canal, and occasionally some little distance. The elongated annular stricture usually arises from consolidation of the corpus spongiosum by plastic matter compressing the urethra, as in Fig. 478. In other cases, again, annular strictures are narrow and sharp edged, and are then called “ pack-thread ” or “ lamina ” strictures ; consisting of bands stretching across the urethra (Fig. 479). Sometimes there are several of these in close proximity to one another, leaving merely narrow passages between or under them. These bands occasionally stretch directly across the canal, but at other times and more commonly they take a somewhat oblique direction (Fig. 477). It is not clear how these bridles or fræna stretching across the urethra are formed ; they can scarcely be by the effusion of plastic matter ; it is more probable they are occasioned by a valvular projection of the mucous membrane which has been perforated, perhaps by the point of the catheter, and thus narrow apertures produced in it. These various kinds of organic stricture are hard and elastic ; sometimes, when old, almost cartilaginous in their feel, and feeling gristly and rough to the instrument that passes over them.

Amount of Constriction.—This varies greatly in organic stricture, from merely slight narrowing of the channel to almost complete obstruction of it.



Fig. 476.—Bridle-Stricture.

Fig. 477.—Stricture at the Anterior part of the Urethra.

Fig. 478.—Stricture from Condensation of Corpus Spongiosum.

A question has arisen whether the canal of the urethra is ever rendered completely impermeable by a stricture. In answering this, it is necessary to be agreed upon the meaning of the term "impermeable." If by it be meant impenetrable to the passage of a catheter, there can be no doubt that such strictures may occasionally, though very rarely, occur; the channel being so narrow, oblique, or tortuous, that the instrument cannot be passed through it. Strictures, however, of this description, may usually be ultimately made permeable to instruments by proper and careful treatment. If by "impermeable" is meant generally impervious to the passage of urine, there can be no doubt that such a condition does not exist. It would clearly be incompatible with life, unless a fistulous opening existed behind the stricture, through which the urine might pass out; and, even with such an aperture existing, I have never heard of or seen a case in which no urine whatever escaped by the meatus, unless in consequence of injury or disease a portion of the whole calibre of the urethra had sloughed away; and it is clear that, so long as any passes out in this way, a stricture cannot be looked upon as truly impermeable.

Mechanical Results.—When an organic stricture is once formed, it will continue unless removed by surgical means; and as it usually becomes more closely contracted, it will offer an increasing obstacle to the free flow of the urine, and thus eventually tend to give rise to important structural changes in the urinary apparatus.

The urethra behind it becomes increased in diameter, sometimes dilated into a true pouch, in which sabulous masses, and even small calculous concretions, occasionally collect. The bladder, subjected to increased pressure by the necessity of overcoming the obstacle to the passage of the urine, becomes thickened and fasciculated. The ureters are often found dilated, from a tendency to a reflux of the urine, or to compression of their vesical orifices, in consequence of the altered structure of the bladder. The kidneys become irritated, congested, and at last the seat of some of these various structural

changes which, by impairing their functions, and interfering with the general depuration of the blood, may eventually destroy the patient.

Symptoms.—The amount of constitutional disturbance set up by a stricture will vary greatly in different cases. In many, and in most instances, it is not very great. The extent to which the constitution is influenced will generally be in proportion to the tightness and extent of the stricture; but it is surprising how much constitutional disturbance is set up in some systems by a stricture, even though it be not very tight. Interference with the free flow of the urine causes irritation of the bladder and kidneys, the secretion from which becomes less abundant than usual. In consequence of this, the actions of the skin and other depurative organs are deranged, and thus the system at large is influenced and suffers. In some cases, again, the constitutional symptoms are rather of a nervous character, the patient suffering not only great pain in micturition, but being attended with rigors, followed by nervous prostration, each time the urine flows over the tender and irritable surface.

The *Local Signs* of stricture are always well marked, are very constant, and are dependent simply on the mechanical obstacle presented by the contracted urethra to the free escape of the urine. The disease commences with the retention of a few drops of urine after evacuation of the contents of the bladder. The patient finds that he has to pass urine more frequently than usual, particularly at night; there is some straining, and a slight gleet discharge, and a feeling of weakness about the perineum. The stream of urine has changes impressed upon it during its passage, and the stricture, by which its shape and direction are modified, thus it becomes forked, scattered, twisted, fan like, or be discharged in two currents—one projected directly forwards, the other dropping perpendicularly downwards. As the disease advances, these signs necessarily become more marked, until they may terminate in complete retention; they, however, often come on in a very insidious manner, and when the patient receives advice he is found to be already the subject of a very tight and extensive stricture; indeed, in some cases, the first circumstance that directs the attention of the patient to his complaint is the sudden occurrence of retention of urine.

Examination of the Urethra.—The existence of stricture can be determined with certainty only by the introduction of an instrument down the urethra. In exploring the canal in a suspected case, two points have to be ascertained—the existence of a stricture, and its degree of tightness. The existence of a stricture is best determined by passing a plated steel sound, or a catheter of medium size, about No. 8, well oiled and warmed. This will readily pass as far as the constricted point, but will then be arrested. In this exploration, too small an instrument must not be used, lest it hit the fossæ of the urethra or against the verumontanum, and this would be mistaken for the obstruction produced by the stricture, and it might pass through the stricture, and thus mislead the surgeon. The existence of a stricture having been ascertained, the next point is to determine its degree of tightness. This is best done by withdrawing the instrument just used, and then introducing a smaller one of about the size of the stream of urine that the patient passes. If this fail to enter the stricture, a smaller one still must be used, until that size is reached, which can be introduced with but a moderate degree of force. In this way the existence, the extent, and degree of tightness of the stricture, are ascertained. The tact of an experienced surgeon will also lead him to judge to a certain extent of the length, degree of induration, &c., of the constriction.

The employment of soft wax bougies has been recommended with the view of taking a mould of the size, shape, and direction of the stricture, by pressing the end of the instrument into it; but no possible advantage can be derived from this proceeding, and a surgeon accustomed to the use of metallic instruments can obtain all this information with more certainty by the finer touch afforded by them.

Treatment.—The treatment of stricture of the urethra may be conducted by four methods:—1, *Gradual Mechanical Dilatation*; 2, *Caustics*; 3, *Forcible Expansion or Rupture*; and 4, *Division of the Contraction*. Whatever plan of treatment be adopted, the surgeon must bear in mind that his operations have to be conducted upon a tender canal endowed with exquisite sensibility, which sympathises closely with the conditions of the general system, and in which improper violence or too active measures may set up a degree of irritation that will readily extend to neighbouring structures, and thus jeopardise the life of the patient. But, though it is necessary to recollect all this, he must not run into the opposite and equally dangerous extreme of adopting inefficient measures for the removal of the obstruction. A bad stricture is one of the most serious diseases to which the human frame is liable, and will almost inevitably, if left to itself, terminate fatally by the induction of renal disease; and we must therefore not hesitate to adopt sufficiently energetic measures for its removal; and if these be properly conducted, there is scarcely any affection in which the surgeon can afford his patient greater relief than in this. At the same time, however, that local means are being used, constitutional treatment should not be neglected. Organic stricture is often more or less associated with spasmodic or congestive stricture, and requires the same constitutional treatment, modified according to circumstances, that is necessary in these affections—proper regulation of diet, avoidance of all articles of food that generate lithates, care not to allow the urine to become too concentrated; and attention to the maintenance of the healthy action of the liver and skin will tend much to increase the patient's comfort, and to ward off the more serious consequences of stricture.

1. **GRADUAL MECHANICAL DILATATION**, as it is erroneously termed, is the usual and certainly the most successful mode of treating ordinary strictures; but it is not the mere stretching or forcible dilatation of the stricture that cures it. The means employed to produce dilatation tend to promote the absorption of those plastic matters effused in and underneath the mucous membrane, which especially constitute the stricture, and thus to occasion a permanent cure.

The instruments that are used for dilatation are either metallic, such as silver catheters, steel sounds, plated or pewter bougies; or made of some soft and yielding material, as gum-elastic catheters, catgut, wax, or elastic bougies. Though each surgeon will mostly prefer one kind of instrument to another, it is well not to be too exclusive in the use of any one; for it will be found in particular strictures and certain constitutions that it is advantageous to depart from the ordinary practice, and that the surgeon may modify with great benefit to his patient the mechanical means that he adopts. As a general rule, I think that metallic instruments are decidedly preferable, more especially when the stricture is tight, cartilaginous, and of old standing; nothing will pass such a stricture as thus so readily as a well-made steel sound or silver catheter.

The shape and curve of *Catheters* and *Sounds* is of much importance; the best curve for these instruments, I think, consists of the one fourth of the circumference of a circle $4\frac{1}{2}$ inches in diameter. If sounds be used, they

should be made slightly conical, so numbers between the point and the bend of the instrument. They are particularly useful when the ment. The sound should have a sensation communicated to the p. If a catheter be used—and this in tures, in which, if the difficulty tageously be left—it should be ma be large, so as to serve for a han somewhat depressed, so that the instruments should be used with though no one more strongly reco ploying unnecessary violence in th of passing through a tight hard at degree of force. The catheter of as it may in a healthy urethra; b hand of the surgeon, and there requires more tact and delicacy instrument through a tight, or, Here some force must be used, this to the amount of resistance, appearance of force is indeed oft the point of the catheter have pa require considerable pressure to p

Introduction.—Catheters and the patient flat upon his back, w head and shoulders low. The sur instrument well warmed and oiled towards the left groin, and pass drawing the penis upwards with membrane on the stretch. As t ligament, the handle is carried to raised perpendicularly; and, as it be kept well against the upper sur bladder by depressing the handle to guide to the bladder is the upper than the lower, and less liable to passages. Should difficulty be

litated by injecting olive oil before passin

If the stricture be somewhat difficult and then the plan advantageously employ bougie, and bending inch from the point, more closely. In impassable may be

Under the influence may be readily passed pervious in any other

Fig. 479.—
Catheter Bougie
bent to shape
of stricture.

use in passing catheters through re netrable for months or years with

Gum-elastic Bougies and Catheters, and Wax Bougies, are not nearly so manageable as metallic instruments, as they usually bend back against tight strictures; in fact, it is only in those of a spasmodic and congestive kind, in which a large instrument will readily pass, that they are of much service. They are usually best introduced whilst the patient is standing, and they generally glide most readily into the bladder if they have been slightly curved before being passed. When they are of wax, it is useful to smooth them down between the fingers before introducing them. In using the elastic catheter, a stylet is usually required; but in some cases the instrument appears to enter more easily without this. In others, it may be passed with the stylet down to the stricture; and then, on partially withdrawing it, the point of the catheter will start up, and thus more readily slip in.

Results of Introduction of an Instrument.—The introduction of an instrument usually gives rise to a smarting, painful sensation in the urethra; it is generally most severe as the point approaches the neck of the bladder, and is then sometimes attended by nausea and sudden faintness. As a general rule, the instrument should be passed every second or third day, and when introduced should be left in for about five minutes, or until the spasm about the urethra induced by its introduction has subsided. If, however, the stricture be extremely tight, a very small catheter only having been introduced, the instrument may be left in for twenty-four or forty-eight hours, when it will be found that, however tightly grasped it originally had been, it has become loosened; a slight discharge being at the same time set up from the urethra. It may then be readily withdrawn, and, when the irritation has subsided at the end of a couple of days, a considerably larger one may be introduced.

The augmentation of the size of the instrument should be very gradual. It is fully sufficient to increase it by one number at each time of introduction. Many urethra will not bear even this, and it becomes necessary to pass the same instrument on two or three successive occasions before a larger size can be introduced. The size of the instrument may be gradually increased until that is reached which the urethral orifice readily admits; beyond this, the surgeon should not go; but so soon as the full size, usually No. 12 or 14, can be introduced with ease, it should not be passed so frequently as before; once a week or ten days, and gradually with less frequency. But for some length of time it will be necessary to introduce it at least once a month or six weeks, lest contraction take place again.

If the size of the instrument be increased too rapidly, irritation may be set up, and inflammation of the testicles, and abscess in the perineum or prostate, induced. I have more than once had occasion to regret being in too much haste to increase the size of the instrument; and, by augmenting it by two or three numbers at one sitting, have seen the patient thrown back for weeks by the supervention of some of the affections just mentioned.

When the stricture is situated solely at the urethral orifice, the best instruments for dilatation are *nail-headed styles* of graduated sizes. These strictures are, however, very troublesome, and have a great tendency to relapse.

By gradual dilatation, properly carried out, most strictures may be considerably relieved in the course of a few weeks; and the majority may be cured by continuing the treatment for a sufficient length of time. Some, however, cannot be cured in this way; it would appear that the tissue of which they are composed is so contractile that, although they may be expanded up to a certain size—say up to No. 5 or 6—it is impossible to go beyond this. In other cases there is a great tendency to relapse, and

to a return of the constriction; the stricture rapidly becoming tight soon as the introduction of instruments is discontinued, even though the stricture be dilated up to the full size of the urethra, up to a No. 10 catheter, for instance. In some instances the relapse is almost instantaneous, micturition being as difficult as before as soon as the catheter is withdrawn. In these cases recourse must be had to other measures, which will be described.

Accidents attending Catheterism.—The introduction of instruments occasionally gives rise to certain troublesome and even dangerous accidents. Amongst these, syncope and rigors, hemorrhage, and inflammatory action about the urethra or testes, are the most common. In certain constitutions, usually of a nervous and irritable character, there is a great tendency to the occurrence of *shivering and faintness* after the passage of an instrument, more particularly as it approaches the neck of the bladder. These usually go off after the withdrawal of the catheter, but in some cases may continue for many hours, or even come on after the lapse of some time, the rigors in these circumstances being very distinct and intermittent, much so as to resemble an ague-fit. In such cases as these a full dose of opium powder, or of laudanum, in some warm brandy and water, will usually afford the patient most relief. This accident is seldom attended with any danger, should the kidneys happen to be much disorganised, death may ensue. In one case I have known this happen at the expiration of nine hours after the continuance of the syncope; in another instance, in two days, from retention of urine, and this even though no material difficulty was experienced in passing the instruments.

Hemorrhage, which is sometimes rather profuse, may follow the introduction of a catheter, especially if the stricture be congestive, and the instrument employed, small. It generally ceases of itself; but, if it be troublesome, application of cold will check it.

The inflammation about the urethra and in the testes that occasionally occurs during the treatment of stricture, is best guarded against by using too large catheters, and by directing the patient to abstain from exercise during the time of their introduction.

False Passages are occasioned by the instrument passing out of the urethra through its coats into the surrounding tissues. They are especially apt to occur in tight bridle-strictures, when a small instrument is used, and more especially if the direction of the constriction be somewhat oblique, so that the point of the sound is thrown against the side of the urethra (Fig. 476). The extent and situation of a false passage necessarily depend according to the position of the stricture; and the danger is usually in proportion to its depth. The false passage usually takes a direction downwards and to one side of the urethra. If the stricture be far forwards, it may pass into the corpus spongiosum, but if in the usual situation, it may perforate the lateral lobe of the prostate, or run between this and the rectum, and be unable to extend upwards on account of the rigid nature of the stricture in this situation. When the false passage merely perforates the corpus spongiosum, running parallel to the urethra, and opening again into the urethra, or when perforating a portion of the prostate it enters the bladder, it is necessarily attended with much danger; but when it enters the cellular tissue between the bladder and the rectum, breaking up this structure to a great extent, admitting urine into the recto-vesical space, and ascending to the neck of the bladder, then the most serious consequences, such as inflammation and abscess in this neighbourhood, are apt to ensue, which are almost invariably followed by the death of the patient.

At the moment when a false passage is made during the introduction of an instrument, by the surgeon using too much force or pressing in the wrong direction, he feels the point make a sudden slip, which the direction of the shaft indicates to be to one side of the urethra. The patient complains of severe pain, and is often conscious of a laceration; there is a grating or rough sensation communicated by the tissues against which the instrument has passed; and though it have entered deeply, it will be found not to have reached the bladder. On the surgeon introducing his finger into the rectum, he probably feels the point of the instrument in the cellular tissue between the gut and the bladder; on withdrawing it, it will be found covered with blood, and there will be free hemorrhage from the urethra.

The surgeon knows when he has entered an old false passage by the change that takes place in the direction of the instrument, by its not reaching the bladder, and by the rough sensation communicated to it, very different from that afforded by the smooth lining of the urethra. The patient is often conscious of the existence and of the entry of the instrument into the false passage, and will warn the surgeon of it. If the surgeon be aware that he has made a false passage, he should, if possible, at the time of the accident pass a larger catheter into the bladder, and leave it there for a few days until the laceration has healed. If there be an old false passage he must be careful, by keeping the point of the instrument away from it, not to enter it, lest during the introduction of the catheter he raise with the point of the instrument the valvular angle that intervenes between it and the urethra; every time that this is opened up it tends to lessen the chance of a closure of the aperture, whilst, overlapping the urethra, it interferes with the onward passage of the instrument into the bladder. By withdrawing the instrument and changing its direction, the false passage may often be avoided, and the bladder reached. Should there have been much difficulty in introducing the catheter, the better plan will be to allow it to remain in the bladder for two or three days, when the false canal may possibly close.

It has already been stated that in certain forms of stricture, gradual dilatation does not succeed in effecting a permanent cure. In these cases three plans of treatment have been recommended—the destruction of the stricture by caustic, forcible dilatation, and its division by the knife. These methods will now be described.

2. CAUSTICS.—In the treatment of stricture by caustics, two objects are endeavoured to be attained; the first is the destruction of the stricture; the second, the diminution of the sensibility of the surrounding mucous membrane, so that the irritability and spasm of the canal may be lessened. The following is the way in which the caustic is applied. A wax bougie, well-oiled, is passed down to, but not through the stricture; the surgeon then, with the thumb nail, makes a notch on that portion of the instrument opposite to the meatus. Another bougie of similar length and size is then armed by a piece of potassa fusa of about the size of a small pin's head, placed in a depression at its end. A mark is now made on it, at a point corresponding to the notch on the first bougie; it is then passed rapidly down until this mark comes opposite to the meatus, and then pressed firmly for two or three minutes against the stricture, upon which the caustic exercises its action. This application, which is followed by a gleet discharge, is to be repeated every second or third day until a proper sized bougie can be introduced; and then the dilatation may be proceeded with in the usual way. This practice, stigmatised, not unjustly, by Liston as "most atrocious," has now but few advocates; and, indeed, there appears to be nothing useful

effected by it, beyond what can be accomplished much more safely and by a catheter or sound in an ordinarily skilful hand.

3. **FORCIBLE EXPANSION OR RUPTURE.**—Forcible and rapid dilatation causing the expansion and rupture of the stricture, is a method originally proposed and practised many years since by Luxmoor, Dr. and Buchanan of Glasgow, has of late years been revived in principle, ingeniously modified in detail, by many surgeons, among whom Maisonneuve, Perreve, Wakley, Holt, and Thompson are the most conspicuous. However varied the means by which strictures are thus the instruments employed may be arranged in three groups: *a.* Those that act as sliding tubes; *b.* Those that expand by a screw mechanism. Those that act on the principle of a wedge.

a. Sliding Tubes were first employed in the treatment of stricture by Desault at the close of the last century, subsequently by various surgeons, and of late years by Hutton of Dublin, and very extensively and successfully by Wakley. The mode of application of these tubes is as follows. A long conductor is passed through the stricture into the bladder, and over this a catheter, either of gum or silver, is passed, which on turn is made to serve as a conductor to a larger one. In this instrument the conductor, or "urethral guide," consists of a small catheter, which, after being passed through the stricture, has a long rod screwed into it. Over this a silver tube is passed, which is also made to serve as a conductor; and thus the stricture may be rapidly dilated by passing one tube over another until a full size is reached. The difficulty in this very ingenious method—which is, however, common to every other plan of treating stricture by dilatation—consists in the introduction of the "urethral guide;" when that has once passed the stricture, the tubes must follow as a matter of necessity. They may possibly go wrong; and, as no laceration or rupture of the stricture can be effected by the instrument, it appears to be a peculiar means of employing rapid dilatation when circumstances seem to require it.

b. The method of forcibly expanding a stricture by the introduction of a small two- or four-bladed instrument, fashioned somewhat like a narrow beaked sound, and which, by screw mechanism in the handle, of being opened out so as to stretch the stricture to an extent corresponding to the distance at which the blades are screwed apart, has many advantages, and various ingenious contrivances have been invented to effect this. More than half a century ago, Luxmoor attempted it by the use of a two-bladed instrument. Subsequently Civiale invented a structure-expander, and of late years two-bladed instruments, having this end in view, have been introduced into practice by Perreve, Lyon, and H. Thompson.



Fig. 480.—Thompson's Stricture-Expander.

The accompanying drawing (Fig. 480) is a representation of the instrument by the latter gentleman; it answers admirably the intended purpose of expansion of the blades being effected by a screw worked by turn of the handle. This should be done very slowly, several seconds being allowed to elapse between each turn of the handle, so that the tissue composing the stricture may be gradually stretched, and the canal of the urethra at the point of stricture dilated beyond the full size, so as to be over-stretched, the

of dilatation may be carried up to 16 or 18, and is marked on a scale attached to the handle of the instrument. If this operation be done slowly, little if any bleeding results, and there is no evidence of laceration of the wall of the urethra at the strictured spot. A large gum catheter may then be passed, and the urine drawn off. It is not usually necessary to leave the catheter in the bladder, though there can be no objection to doing this for forty-eight hours, after which the patient may have one passed occasionally in order to maintain the dilatation.

c. The rupture or splitting of the stricture by an instrument acting on the principle of a wedge, has been recommended by Reybard and Holt, and very extensively and successfully employed by the latter excellent surgeon. The instrument used by him is represented in the accompanying figure (Fig. 481). It consists of two grooved metallic blades joined at the extremity



Fig. 481.—Holt's Instrument for Splitting Strictures.

Between these a tube is slipped along a wire, which in its descent separates the blades at a considerable angle, and thus splits up the stricture. In this way the contracted part of the urethra is at once enlarged to its normal diameter, so as to admit a full sized catheter, by which the urine is then drawn off. The introduction of the catheter should be had recourse to at first on alternate days, and afterwards at longer intervals. Holt has treated nearly three hundred strictures with this instrument, with the most perfect success, and without the occurrence of infiltration of urine, abscess, or other mischief. He believes that the effects of the dilatation are entirely confined to the morbid contraction, the healthy portion of the urethra not being injuriously disturbed by the expansion of the instrument.

4. DIVISION OF THE STRICTURE may be practised either from *within* the urethra, or from *without*, through the perineum.

INTERNAL URETHROTOMY.—The division *from within* may be performed in two ways; either by cutting through the stricture from before backwards, or by passing a proper instrument through it, and dividing it from behind forwards.

The first method—that of perforating the stricture *from before backwards*—consists in passing a concealed steel stylet down to the stricture, and then pushing forwards the lancet like knife, attempting to perforate the obstruction. This plan is necessarily attended by the most dangerous consequences, if an attempt be made to thrust a stylet through the stricture without a guide; the probability, indeed almost the certainty, being that the pointed cutting blade will pass by the stricture and divide the healthy wall of the urethra. It is, indeed, almost banished from surgical practice, and is only applicable with safety to those strictures that are situated in the part of the urethra anterior to the scrotum, where the canal is straight. In the deeper and more curved parts, any attempt at perforation would obviously be fraught with danger; for, as it would of course be impossible for the surgeon to guide the stylet exactly in the direction of the urethra, it would be more likely to perforate the walls of this canal than to pass through the stricture. In hard and resisting contractions, however, in the straight portion of the canal anterior to the scrotum, such an instrument may occasionally be used with advantage. A very convenient form of cutting stylet is the one figured here, which has a probe end, that is introduced through the stricture, and serves as a guide

to the blade, which is projected and the action of a spring (Fig. 482).



Fig. 482.—Lancetted Stylet.

The other mode of dividing strictures is from behind forwards. This is done by passing a stylet through the stricture, and then the instrument is withdrawn, notching the obstruction. The stricture must be of considerable size to admit of a No. 6 catheter, it is usually sufficient, and this procedure will therefore succeed if the stricture is situated at the meatus, or in the bulb, or in a narrow probe-pointed bistoury; and if the stricture is down the canal, its section may be effected by a slender sheathed blade, which is then divided as the instrument is withdrawn.

The internal division of strictures has always been a favourite method of treatment, and is not a few complicated and dangerous operations, but by a process of cutting or laceration, may be effected. Civiale, however, to whom the operation is owing, has invented various instruments, has invented a



Fig. 483.—Civiale's Instrument.

division of the stricture may be safely effected, however, as with all other urethrotomy, the instrument must be about No. 5. The end of the instrument is a small blade having been made to pass downwards by a firm and steady pressure. The blade is then shut into the stricture, and a No. 10 catheter is passed, and the operation being afterwards completed, the patient is confined to bed for three or four weeks. This operation is attended with much pain, and usually by the loss of blood.

In performing internal urethrotomy, it is of great importance to bear in mind that the stricture may be pushed back by the instrument to the distance of about an inch, with a view to steady the urethra by drawing the stricture back, and then the section of the stricture is attempted by a sawing motion rather than by a cutting motion.

The operation of internal urethrotomy, as mentioned, appears to be attended with much pain, and diminishes in exact proportion as the stricture is removed from the urethra. It is of course only reg-

chiefly resilient or very irritable strictures. In resilient strictures dilatation fails, because the stricture, though admitting of expansion, immediately relapses. In very irritable strictures, the patient cannot bear the pain of dilatation. In both these classes of cases, the division of the stricture from within removes at once all difficulty in treatment; and I have of late years employed this very simple method in several cases of this kind with the most marked and permanent success. In fact, in strictures of the scrotal or penile portions of the urethra, where one or other of the above conditions—resiliency or irritability—generally prevails, I now very commonly notch the constricted portion of the canal by means of Civiale's arethrotome, and thus at once, and with great ease, obtain much, if not all, the space required.

EXTERNAL URETHROTOMY.—The division of the stricture *from without* by incision through the perineum, may be performed by two distinct operations: the one being only applicable to those strictures that are pervious to an instrument; the other to those which are impermeable. In the first case, a grooved staff is passed through the stricture, and the section is made upon this. In the second case, the surgeon attempts to cut into and through the stricture, without any guidance except such as his anatomical knowledge may afford him.

Operation for Permeable Stricture.—The first of these operations introduced by Syne as *Urethrotomy*, and commonly called the *Perineal Section*, is comparatively a simple procedure. The instruments required for its performance are a staff, a No. 8 silver catheter, a pointed scalpel, and a broad director. The staff should vary in size from No. 1 to No. 6, according to the tightness of the stricture; it should be grooved along its convexity, either the whole of the way, or better, merely for the lower third (Fig. 484). The stem is smooth and of full size, and joins into the lower grooved part by a distinct shoulder, which, being passed down as far as the stricture, forms by its projection a guide to that part of the urethra requiring division. In those cases in which there are false passages, a hollow staff of the same size and shape may be advantageously used, the flow of urine through it indicating with certainty its passage into the posterior part of the urethra.

Performance of Perineal Section.—The operation is performed as follows. The staff having been passed well through the stricture, so that the shoulder rests against the upper part of the constriction, the patient is tied up as for lithotomy, and the surgeon, seating himself in front, pushes the scalpel, with the back of the blade downwards, into the mesal line of the perineum a little above the rectum, and cuts upwards for an inch or more in the raphe. The dissection is carried on very carefully exactly in the median line until the staff is reached, when the knife must be entered into its groove behind the stricture, and carried forwards through this. The staff, having then been pushed on to ascertain that all is free, must be withdrawn, and a No. 8 catheter introduced, which is to be kept in for forty eight hours; it must then be taken out, and at the end of eight or ten days the urethra must be dilated by the introduction every second day of a full sized silver catheter. Urine escapes for some little time by the perineal incision, but as this heals by granulation, the flow of fluid gradually lessens and at last ceases entirely.

The principal points to be attended to in this operation are—

1. To see that the staff is fairly through the stricture, and to be especially careful in determining this if false passages exist.



Fig. 484.—Shouldered Staff for Perineal Section.

2. To cut carefully in the middle, where there can be no danger what might happen if any lateral vessel, indeed, which is at all, this may always be avoided by cutting towards the side of the incision.

3. To enter the point of the knife by cutting forwards in the groove of the urethra.

4. Not to turn the edge of the knife, so that the deep perineal fascia may be opened without inflammation incurred.

5. Much difficulty has occasionally occurred in passing a broad director, with the view of dividing the stricture of the urethra after the stricture has been drawn. As the catheter is passed and guided by this onwards into the bladder.

When there are more strictures, the use of the catheter is usually alone necessary; the other is not.

Result.—The result of the perineal operation is usually satisfactory; in which a fatal termination has been known to occur. It is for this reason to believe that these cases are not advocates of this operation have ever, there are no trustworthy statements to enable us to speak positively as to the result of the operation. Occasionally, an incurable stricture of the perineum; and not unfrequently a stricture, such as inflammatory oedema, have been found to supervene.

The whole value of urethrotomy in the case of a stricture to return after its division by any means satisfactorily determined which it has been practised has in the present session; and until this has been determined by operation as established, except in the kind just mentioned. Much dilatation of the urethra for some time, a catheter of full size being passed, and no precaution be neglected, relapses are not infrequently attended to they are. Against urethrotomy it has been argued that the urethra might occasion a cure, and eventually tend still further to less. *Mortem* examination of patients in whom the operation had been performed has shown the cicatrix being linear and scarcely different in the result, between cases in which it was transversely and those in which it was linear. In the first instance, a dense and contracted stricture; in the second case, a linear and scarcely perceptible stricture.

Comparison of Methods of Treatment.—The connection with the several operations is as follows:

should be practised. That most strictures may be cured by gradual dilatation, there can be no doubt; most practitioners holding with Liston, that whenever a catheter will pass through a stricture, its cure by dilatation is in the hands of a skilful surgeon. Though this may be generally true, instances not unfrequently occur, in which simple dilatation fails to effect a cure; the stricture being highly contractile, and not admitting of expansion beyond a certain point, or relapsing whenever the dilating means are removed. In other cases, also, the patient suffers so much pain and irritation whenever an instrument is passed, that he cannot bear the repeated introductions that are necessary, more particularly if the stricture be complicated with fistule in perineo or false passages, which render its cure by dilatation tedious and almost impracticable. In such cases as these the surgeon, being unable to benefit his patient materially by dilatation, must choose between the employment of palliative means or more active measures.

It appears to me that there are four classes of cases in which more energetic means than simple dilatation may not only be advantageously employed but are absolutely required.

1. In *very old dense cartilaginous strictures*, often of traumatic origin, which admit an instrument with great difficulty, and cannot be dilated beyond a certain point, owing to the conversion of the urethral structures into a kind of dense, fibrous, almost cicatricial tissue, which neither admits of expansion nor of absorption by the pressure of instruments; and in which a considerable extent—half an inch or more—of the urethra is involved.

2. The same kind of stricture, complicated with *fistulæ* in the perineum or scrotum, with perhaps considerable plastic infiltration of these parts. In both these classes, I think that the perineal section or external urethrotomy is the preferable operation.

3. *Very tight structures*, accompanied by *excessive sensibility* of the urethra; in which each introduction of the instrument is attended by intense suffering, spasmodic movements of the limbs, and rigors, so that the patient cannot be induced to submit to a proper course of bougies.

4. *Very elastic*, though perhaps *narrow strictures*, that can be dilated readily enough, even up to the admission of full-sized instruments; but which, when the treatment is discontinued, immediately begin to contract again, so that the patient is never out of the surgeon's hands, and sees no prospect of cure.

In these last two classes of cases, I am of opinion that internal urethrotomy with Civiale's instrument, or the forcible expansion or rupture of the stricture, is the best method of treatment; the perineal section being too severe and dangerous, whilst simple dilatation is too feeble a means of treatment.

Impermeable Stricture.—In order to perform the perineal section, the stricture must be pervious to a grooved staff, however small this may be; and this, it might be supposed, would limit materially the cases in which the operation can be performed. But complete obliteration of the urethra cannot take place except as the result of sloughing, usually from injury; indeed "impermeable" strictures, though frequently spoken of, are very rarely met with. Syme, indeed, denies their existence, and states that if urine can escape through a stricture, a bougie can be introduced. A surgeon may often be foiled in his first attempts in passing an instrument through a very tight stricture; but I believe that, with patience, by attention to constitutional treatment, so as to lessen urethral irritation, and especially by the administration of chloroform, he will usually at last succeed in making an

instrument of some kind pass through the very worst strictures. In case in which I performed the perineal section, almost all the urine twelve years been discharged through fistulous openings in the perineal scrotum; and the principal portion escaped through a large hole inside of the left thigh, a few drops merely occasionally passing out lips of the urethra. No instrument had been passed for four years; repeated attempts had been made by different surgeons. Being introducing a catheter into the bladder the first time I tried, I patient in the Hospital for two or three weeks, attending careful constitutional condition, but without making any further effort. then placed under chloroform, when I succeeded in passing No. 5 urethra was then dilated up to No. 5, beyond which no instrument passed, when the perineal section was performed. The patient an excellent cure, the fistulous openings closing, and the urine being discharged by the natural channel. In another case, which I attended with Mr. persevering attempts had been made for five years to make an instrument enter the bladder, but without success, the stricture not only being very tight, but the urethra acutely sensitive; under chloroform I succeeded in introducing No. 4 silver catheter into the bladder, and speedily cured patient. In a case of extravasation of urine following stricture, caused on injury of the perineum, sent to me by Mr. Corrie of Funcher, no catheter had been introduced for eight years, it was found at that, although the urethra had been converted into a mass of cicatrix at the part injured, it was yet permeated by a narrow tortuous channel through which the urine had escaped.

The influence of *Anæsthetics* in facilitating the passage of instruments through apparently impermeable strictures is very marked. Since the introduction of ether as an anæsthetic agent, Liston was enabled to pass through a stricture that had resisted all attempts made by his numerous hand at introducing an instrument into the bladder, but it was the patient put on the table and fairly rendered insensible. No. 8 silver catheter, which had been passed down as far as the point of which was to serve as a guide to the knife, slipped out of the bladder, and thus rendered a dangerous operation unnecessary.

Yet no surgeon can doubt that cases do occasionally, though rarely, in which, in consequence of extravasation of urine and old inflammation, the urethra has become so tortuous and narrow, and the parts indurated and disorganised, that an instrument cannot be passed, even though urine pass out readily. It must be borne in mind that the urethra may be permeable to urine, but impermeable to a catheter, even most dexterous hands. It does not follow necessarily that, because urine will trickle out of a narrow and tortuous channel, a catheter or bougie can be passed into it from without. Hence cases will occasionally occur in which the perineal section is not practicable.

In the event, therefore, of a stricture being so tight and tortuous that no instrument will pass through it, or where, a portion of the urethra having sloughed away, its canal is obliterated, neither the cure by division of the urethra nor urethrotomy can be performed, and it may then be necessary to have recourse to incision of the stricture without a guide.

Operation for Impermeable Stricture.—This operation is performed as follows. A No. 8 silver catheter is passed down to the point of the stricture. The patient is then tied up as if for lithotomy; and the surgeon, sitting on a stool, pushes a bistoury with the back turned towards the rectum, and divides the urethra as far as the apex of the prostate, or as far as possible, if possible,

the dilated urethra *behind* the stricture. He then cuts *forwards* through the stricture on to the point of the catheter, and having thus opened a passage, endeavours to pass that instrument on into the bladder. It is often extremely difficult to find the posterior part of the urethra; but in some cases this part of the operation may be facilitated by passing a grooved director or straight female catheter into it to act as a guide. When the tissues of the perineum are hard and gristly, altered by the effusion of plastic matter, and condensed by repeated attacks of inflammation and the existence of fistulae, it is a most difficult matter to dissect through such an altered mass and hit the urethra beyond it; and the difficulty is still further increased by the bleeding, which is often profuse.

This operation, I have no hesitation in saying, is perhaps the most troublesome in surgery. I have more than once seen the most skilful operators foiled in their endeavours to accomplish it, and compelled to relinquish the operation without concluding it, or only succeed after prolonged and most painful attempts. Fortunately this operation is now scarcely ever necessary; with patience and under chloroform the surgeon may almost invariably pass a staff, however small, into the bladder; he then has a sure guide upon which to cut, by following which he must certainly be led through the stricture into the urethra beyond it. In all cases, therefore, urethrotomy should, if practicable, be substituted for the division of the stricture without a guide.

COMPLICATIONS AND RESULTS OF STRICTURE.

RETENTION OF URINE.—This has a tendency to occur in all tight strictures, from the gradual and progressive contraction of the canal. It most usually, however, takes place in consequence of a congestive spasmodic condition being superadded to the organic constriction. It commonly happens that a patient having a moderately tight organic stricture commits an excess, or becomes exposed to cold and wet, and thus gets such a congested condition superadded, that the urine will not pass at all, or only in such small quantity by drops, and with so much pain and straining, that the bladder cannot be completely emptied. In these cases the retention always eventually becomes complete; the bladder speedily fills, and rises above the pubes; there is much distress and constitutional disturbance; and, if relief be not afforded, the distended portion of the urethra behind the stricture will ultimately give way, and extravasation of urine ensue. In these circumstances, it becomes imperatively necessary to empty the patient's bladder as speedily as possible.

Treatment.—This varies with the severity of the symptoms and irritability of the patient. If the retention have not continued very long, and if the patient be not very irritable, an endeavour might be made at once to give relief by passing a small catheter into the bladder. In this the surgeon may often succeed more readily than might have been expected, the stricture frequently yielding before an instrument, more easily when there is retention than when this condition does not exist. Even if the catheter do not enter the bladder, its point or that of a catgut bougie merely being introduced well into the stricture, it will generally happen, as Brodie has pointed out, that, on the withdrawal of the instrument, the urine will follow in a full stream; but if a sufficiently small catheter be used (in many cases not larger than half of No. 1 is admissible), the instrument may usually be made to fairly enter the bladder. If the patient be very irritable it is better, before attempting the introduction of the instrument, to give him an opiate enema of a drachm of laudanum in about two ounces of starch, and to put him in a warm hip-bath; the introduction of the catheter may now be

attempted, and will very generally of the inhalation of chloroform should may be made to pass without the degree of force. There are no cases of value than in these; under its influence will not pass. After the instrument be left there, being tied in by means the patient's thighs, to a bandage of elastic remedies must then be employed, purge, leeches to the perineum if salines with antimony. The catheter end of forty-eight hours, when it should be discontinued proceeded with in the usual way.

If, however, the surgeon be unable to pass the catheter in the ordinary way through the stricture, the bladder in some other way, lest it rupture, urine may occur. The bladder may be opened 1, by making an opening in the Scrotum; 2, by making an Opening in the Perineum; 3, by Puncturing the Viscus, and puncturing it above the Pubes.

1. *Forcible Catheterism* is a method of passing the catheter. Nothing can surely be more important than to pass the catheter, pass it down to the stricture, and drive it on into the bladder. In the attempt at reaching the viscus, but the tissues around the neck of the bladder are great, and perhaps even fatal, unless some fortunate accident, reach the viscus, and forcible expansion of the stricture, and burrowing through the corpus, as it has been termed—until he again reach the neck of the bladder.

2. *Opening the Urethra behind* the stricture. In cases of retention of urine that we are now discussing, the mode of affording relief after the incision into the middle line of the scrotum, behind or through the stricture. It is in cases of retention, than when the urethra being distended by the swelling of the patient, it sometimes attains this be not the case, the operation is not the same. The operation, which is essentially the same as the operation for stricture, described at p. 1180, is to the stricture; opening the distended urethra, cutting upwards through the stricture, then passing the instrument on until urine flow from the aperture thus made. It must be taken to keep strictly in the middle line, to wound vessels of importance. On the stricture may by it be cured at the same time, and as the incisions do not extend to the urethra, there is less danger to the patient.

Another advantage of the perineal operation is, that unfrequently happens that urinary

vasation of a few drops of urine has taken place sooner than the surgeon may have had any idea of: and if so, the incision through the perineum will afford an exit for any extravasated matters, at the same time that it relieves the patient from the distress and danger of the retention. Should any mischief of this kind have taken place, it is not necessary to be so particular about opening the urethra with the knife; for, an aperture having already been established in it, the urine will readily flow through the artificial channel thus formed by free incision into the inflamed or suppurating perineum.

3. *Puncture of the Bladder through the Rectum.*—After emptying the bowel by means of an enema, the surgeon passes the left index-finger well into the gut, feeling for the posterior margin of the prostate; he then carries the trochar and cannula, which are long and somewhat curved, upon this as a guide, and, when the extremity of the instrument has reached the posterior edge of the prostate, he pushes it upwards into the bladder (Fig. 475, b). The seat of the puncture between but in front of the ureters is well shown in Fig. 485, which represents the bladder and strictured urethra of a man who died some days after this operation had been performed for retention from stricture. In performing this operation, the surgeon perforates the bladder in that portion of its fundus which is uncovered by peritoneum, being bounded behind by the reflection of the serous membrane, anteriorly by the prostate, and on each side by the vesiculae seminales. In order to avoid wounding any of these structures, he should keep strictly in the mesial line, and puncture immediately behind the prostate. In introducing the instrument into the rectum, the surgeon should withdraw the point of the stylet into the cannula, so as to avoid wounding the gut, and not push it forwards until he has the end of the cannula fixed against the spot where he intends to make the perforation. After withdrawing the stylet and emptying the bladder, the cannula should be tied in by means of tapes, and left for a few days until urine begins to pass by the natural channel, or until means can be taken to restore the passage through the stricture, when it must be withdrawn and the aperture left to close. In consequence of the irritation of the urine being removed from the urethra, a catheter may often be passed a few days after the operation; and the stricture will readily yield to dilatation in the ordinary way.

This operation has the advantage of being far easier of performance than the last, and may doubtless occasionally be required in those very rare cases of retention from stricture in which there is no sign of abscess or extravasation in the perineum, in which the urethra appears not to be dilated behind the stricture, in which the prostate is not enlarged, and in which, under chloroform, and with patience, a catheter cannot be passed into the bladder; a combination of circumstances that will but very rarely indeed occur to a surgeon skilled in the use of his instruments.

The operation of puncture through the rectum is not devoid of danger; urinary infiltration, and pelvic inflammation and abscess, may result from it. In a remarkable case that was under my care at the Hospital (in 1859), a sequence occurred which I have never seen noticed; viz., the diffusion of rectal flatus through the cellular tissue of the pelvis and down the thighs



Fig. 485. Seat of Puncture through Rectum in a case of Stricture.

and nates, producing an emphysema, and death of the patient. The case was had suffered from traumatic stricture in childhood. He was admitted with a catheter, or could be passed, I punctured the bladder, and the cannula was removed on the fifth day, and continued to do so up to the withdrawal of the cannula he felt no tangible complaint. The next day the part of both thighs were emphysematous with air. The emphysema extended to the arm, appeared even in the right arm. He died on the following day, the only trace of pelvic inflammation, suppuration, or abscess, was not found; but there was much infiltration and in the cellular tissue between the thighs, probably passed through the sciatic foramina. It was fetid, like intestinal gas.

4. *Puncture of the Bladder above the stricture*, is but seldom resorted to, more especially Paget of Leicester practised it. This operation, which is doubtfully easy of performance, and the danger of infiltration of urine into the tissues of the perineum, and of the inconvenience of a fistulous opening, cases to which it appears to be applicable, had occasion to practise it; viz., in a case of stricture, in which there co-exists a large prostatic abscess, and the perineal section dangerous, and the surgeon's finger not being able to pass, and here undoubtedly the safest, the suprapubic puncture.

After the bladder has been punctured, the surgeon may think proper to adopt, the removal of the urethra, so as to prevent the urine from passing into a permanent fistulous opening, and the urine to be voided by the urethra, the stricture in the bladder, where it should be retained, and the small instrument may usually within four to six days. At the expiration of the stricture by dilatation may be removed.

EXTRAVASATION OF URINE.—In the organisation of the coats of the urethra, the stricture, and the urine become infiltrated into the part of the urethra that gives way, the canal, just anterior to or between the two, where it is weak, being least usually most dilated and attenuated, and subjected. This circumstance is a great disadvantage, that stricture of the urethra never occurs in a deeper situation than we do. Was it altogether behind the deep perineal

into the cavity of the pelvis. But, as it is, the connection of the triangular ligament with the ramus of the pubes and the ischium prevents the extension of the infiltrated urine in that direction; and the manner in which the superficial fascia of the perineum is connected with the deep fascia uniformly causes the fluid to take a course forward into the perineum, scrotum, and upwards upon the external organs of generation, the groins, and the anterior abdominal wall; so that it ascends contrary to its gravity rather than soaks back into the more dependent parts of the body, as it would do, were it not for the particular connection of the fasciæ that has just been alluded to. I have, however, known the superficial fascia to give way, and the urine, then gravitating backward, to give rise to extensive sloughing in the ischio-rectal fossæ and about the nates, denuding the rectum.

Local Effects of Extravasated Urine.—The effects of urine that has become acrid and concentrated by long retention, are most deleterious upon those tissues with which it comes into contact. The vitality of whatever portion of cellular tissue it infiltrates is immediately destroyed; the tissue becoming converted into a kind of putrid stringy slough, intermixed with and soddened by a quantity of fetid dark-coloured acrid pus and urine. The ravages of extravasated urine are often extensive; the urethra giving way suddenly behind the stricture, the fluid is driven with all the force of the vital and physical contractility of the over-distended bladder into the perineum, and thence rapidly finds its way through the scrotum upwards. In other cases, again, the extravasation occurs more slowly; a few drops appear first of all to escape from the urethra through a small rent or ulcer in it; these give rise to inflammation in the surrounding structures, by which the progress of the extravasation is for a time limited. It is especially upon the cellular tissue of the scrotum that the effects of the extravasation manifest themselves in their full intensity, causing great distension and rapid sloughing of it. The skin speedily participates in this action, becoming of a dusky-red or purple colour, and then falling into a state of gangrene. In this way the testes may become denuded, and the cords exposed. It is remarkable, however, if the patient survive these destructive effects, with what rapidity reparative action goes on in this region. It is seldom that infiltration extends higher than the groins, or the anterior portion of the abdominal wall; but it may reach the costal cartilages before proving fatal.

When the extravasation is deep, the urethra being opened between the layers of the triangular ligament, the patient, after suffering from retention, experiences a sensation of relief, and as if something had given way in the perineum, followed after a time by throbbing and pain. There may be but little swelling for a day or two, but then a doughy red diffused intumescence takes place in the scrotum and rapidly extends forwards. When the rupture is altogether anterior to the deep perineal fascia, then rapid swelling and infiltration, partly urinous, partly inflammatory, take place in the scrotum and penis: these parts become enormously distended, cedematous, crackling, and emphysematous, with the local signs that have already been mentioned.

The *Constitutional Disturbance* is always considerable; at first it is of an irritative type, but speedily followed by asthenic and typhoid symptoms, by which the patient is at last carried off.

The *Treatment* consists in making a free and ready outlet for the urine as early as possible. This should be done, as soon as the extravasation is known to have occurred, by a deep incision into the middle of the perineum. So soon as any pain and throbbing, with diffused swelling, occur in the perineum, with redness and more or less cedema of the scrotum, the patient should be

drawn to the end of the bed and placed in the position for lithotomy, the surgeon should next introduce his left index-finger into the rectum, the gut may not be wounded, and then, pushing a long sharp-pointed deeply in the raphé of the perineum, cut upward to a sufficient extent the extravasation, and in the direction of the urethra. A catheter then, if possible, be introduced, secured in the bladder, and left unobscured in this way no further effusion can occur, an outlet will be afforded to the matters already effused, and the greater part of the urine will consequently be found to escape after a time by the aperture thus made. Should the extravasation not be seen until extravasation has spread widely, a free incision should not be made into the perineum, extending to the aperture in the rectum, but also into the scrotum on each side of the septum, into the perineum wherever else swelling is observed. The sole chance of safety for the patient lies in making these free incisions, through which the parts may, to a certain extent, empty themselves. However extensive the infiltration of the parts, the mischief may be, we need not despair of the patient if a free outlet can be obtained for the acrid and putrescent urine and effused matter. In order to secure this, the infiltration must be followed by an incision as high as it extends. The parts must, at the same time, be covered with chlorinated and yeast poultices; and the constitutional powers of the patient must be supported by good nourishment and a sufficient quantity of stimulants.

If the patient survive the immediate impression upon the system by the gangrene and the urinary infiltration, he must be prepared to undergo a severe trial to his constitutional powers, in the separation of the sloughs, the profuse discharge, and other sources of irritation that will follow. During this period he will require abundant support, the best being a mixture of egg, ammonia and bark, with any nourishment that he can take, and much attention should be paid to the removal of the sloughs, and to keeping the patient as clear as possible from all local irritation as possible.

URINARY ABSCESS may be considered in many cases as a limited collection of urine mixed with pus, and circumscribed by plastic matter that is deposited in the tissues with which the urine comes in contact. It is generally occasioned by the irritation of the passage of instruments, but may arise from the effect of stricture, or from inflammation of some of the urethral glands. From some cause of this kind a small abrasion or aperture is made in the urethra, a drop or two of urine escapes into the subcutaneous tissue, and this becomes bounded or circumscribed by plastic deposit, so that extravasation does not occur. Such an abscess as this may be situated in any part of the urethra; but it is most frequently met with in the perineal part, appearing to take its origin from the bulb or membranous part. It is not dangerous, but is chiefly of consequence by being commonly followed by urinary fistula.

Symptoms.—An urinary abscess is indicated by the formation of a somewhat circumscribed, hard, and painful tumour, situated in the neighbourhood of the urethra. It is usually unattended by constitutional disturbance; unless it attain any considerable bulk, when some pyrexia ensues. It is principally in the perineum that it attains any degree of magnitude, then constituting a perineal abscess, characterised by a deep, hard, tense tumour, brawny and without fluctuation, attended by considerable weight and throbbing in this region. It does not readily pass to the manner in which it is bound down by the superficial fascia.

Treatment.—Early incision is required. When the abscess occurs

scrotum or anterior to it, the surgeon should wait for fluctuation ; but when it is seated in the perineum, he need not do so, making a free incision through the mesial line into the hard, brawny mass, which must then be well poulticed.

URINARY FISTULE commonly form in the perineum and scrotum as the result of abscess in these regions communicating with the urethra ; occasionally, however, they are met with in other situations, as in the groin, the anterior abdominal wall, or the inside of the thigh. They usually communicate with the bulb or with the membranous portion of the urethra, but occasionally occur anterior to this. In number they vary considerably ; when occurring in the scrotal and penile portions of the urethra, they are usually single ; but when in the perineal, they are often pretty numerous ; several apertures being occasionally met with about the perineum, scrotum, and nates. In one case Civiale found as many as fifty-two. Their size also differs considerably ; some only admitting the finest probe, whilst others are large cloaces. In a case under my care, the patient had a tunnel of this kind in the groin that would readily admit three fingers. They are usually tortuous, elongated, and narrow ; sometimes constricted externally and more widely dilated behind. The surrounding parts are greatly condensed ; the whole of the scrotum and penis is enormously enlarged, indurated, and almost cartilaginous in structure. The urine may escape almost entirely through the fistule, scarcely any being discharged through the urethral orifice ; or there may be but a slight exudation from the fistulous openings.

The *Treatment* of urinary fistula varies according as it is complicated with stricture, and as it is situated in the anterior or posterior parts of the canal.

If there be a stricture, this, as the cause of the fistula, will require removal either by dilatation or by the perineal section. If the stricture be not very tight and hard, dilatation commonly succeeds ; the instrument being introduced every second or third day, until the urethra is dilated to its normal size, when the fistulous tracks will in many cases close. In some instances, however, the frequent introduction and withdrawal of the catheter is a source of irritation, and then it had better be left in. When this practice is adopted, a moderate-sized elastic catheter should be used. If this be too small, the urine will flow between it and the sides of the urethra, and thus escape through the fistula ; if too large, it stretches the urethral orifice of the fistula injuriously.

If the stricture be very tough and irritable, the better plan is to perform urethrotomy at once, as much time and pain are thus saved. In the majority of instances, internal urethrotomy with Civiale's instrument appears to me to be the safest and simplest procedure, which I have very advantageously practised in such cases. But if the fistula be very numerous, so as to riddle the perineum and scrotum in all directions, perhaps the better plan is to perform the perineal section. In this way we not only divide the stricture, and thus at once remove all obstruction, but give a free exit to the urine, which, instead of escaping by tortuous and sinuous passages, finds its way out readily through the new aperture that has been made, which will eventually granulate and heal by the second intention.

The fistula, especially if small and recent, will sometimes heal kindly enough after the removal of the obliteration ; but if extensive, old, and cartilaginous, they are of course little disposed to take on reparative action ; and although the cause that in the first instances gave rise to them may be removed, yet they constitute an independent affection which requires special treatment for its cure.

The special treatment for urinary fistula must vary according to the size

of the canal, but more particularly with regard to the part with which it communicates; whether it be a *Perineal*, a *Scrotal*, or a *Penile* fistula.

If the fistula be *Perineal*, and of small size, a probe coated with nitrate of silver, or a wire made red-hot in the ordinary galvanic current, and passed down it occasionally, may cure it. If it be large, a gum-catheter should be kept in the bladder, and the edges of the fistula freely rubbed with the nitrate of silver, or brought together by quilled sutures. If the fistula be numerous, it will be better to pass a grooved director down the canal, and slit them up so as to throw the several sinusses into one.

When the fistula is *Scrotal*, it often requires to be laid open, made to granulate from the bottom, when it may be found with large sloughy and ill-conditioned cavities in this situation.

When *Penile*, the fistula is usually much more troublesome, the edges are thin, and the track is short and shallow.

Urethroplasty may in such cases be advantageously practised. Operations of this kind require for their success very careful management, attention to detail; they very commonly fail in consequence of a quantity of urine or of mucus escaping through the wound, interfering with union of its lips.

In order to prevent this accident, which is fatal to the operation, the patient should be taught to pass a catheter, and to draw off his own urine after the operation as often as necessary. Should this, however, be impracticable, a full-sized gum-catheter should be passed into the bladder, and properly secured there. It should be left without a plug, so as to prevent the escape of urine from the bladder and consequent likelihood of escape of urine from the urethra and the instrument may take the place of a catheter.

To prevent unnoxious diffusion over the penis and scrotum, a vulcanised India rubber sheath may be attached to the end of the catheter, by which means the flow of the urine is directed away from the patient.

Urethroplastic operations may be varied according to the seat and extent of the fistulous opening.

If the fistula be in the perineum or scrotum, the parts around being thickened and indurated, its closure may often be attained by freely and deeply paring the edges, and then bringing them together with the quilled suture, or by Bozeman's button (Fig. 490).



Fig. 486. — Urethroplasty — Scrotal Operation.

When the fistula is *penile*, there is not sufficient thickness of parts for ready union. Nelaton has recommended the following operation, which is fully practised. The edges of the fistula having been pared, to the extent of about one inch must be dissected up

(Fig. 486) through an opening made below the fistula, the edges of which must then be brought together by a few points of suture. The displacement of the skin causes granulations to spring up, by which the fistula is closed. This procedure may sometimes be advantageously modified by paring the edges of the fistula, making lateral incisions, and then passing across but underneath the flap a slip of India-rubber, to prevent contact of the urine from disturbing the adhesions (Fig. 487).

URINARY VAGINAL FISTULÆ.

Preternatural communications between the urinary passages and the vagina commonly arise from injurious pressure upon and consequent sloughing of the anterior wall of this canal, to a greater or less extent, during parturition. They may, however, occur from idiopathic abscess, or from malignant disease involving those parts.

VARIETIES.—Urinary vaginal fistulæ are essentially of two kinds, according as the communication is established between the urethra or the fundus of the bladder and the vagina. Hence they may be divided into *Urethral* and *Vesical*.

Urethro-Vaginal Fistulæ are, so far as my observation goes, of most common occurrence; and this is readily explained by the fact that the urethra passes along the anterior aspect of the vagina for some distance before it terminates in the bladder, and occupies that portion of the vaginal wall which is most likely to be compressed, during labour, under the arch of the pubes. These fistulæ are usually of small size and linear. *Vesico-Vaginal Fistulæ* establish a communication between the neck or fundus of the bladder and the vagina. They are consequently situated further back than the other, and are usually larger and more ragged.

RESULTS.—The existence of an urinary fistula in the vagina is always a source of serious discomfort and distress to the patient. The dribbling of urine through the preternatural aperture is generally continuous; although, if this be situated far back behind the orifices of the ureters, it may be somewhat intermittent, a flow taking place as the lower portion of the bladder fills. The incontinence of urine thus produced gives rise to irritation and excoriation about the external parts, and occasions a strong ammoniacal odour to hang about the patient.

The precise seat and extent of the fistulous opening are best ascertained by placing the patient on her knees opposite a good light, and holding aside the posterior and lateral walls of the vagina with bent spatulæ; when the anterior aspect of that canal will have a tendency to protrude, and thus to expose the fistula, at the same time that the introduction of a bent probe, or of a female catheter, into the urethra, will guide the surgeon to the artificial opening in the urinary passage.

TREATMENT.—The cure of a vaginal fistula can only be accomplished by causing a confluence of its sides. When it is small, about a line or two in diameter, and more especially if urethral, this may best be effected by touching the edges of the aperture with the electric cautery or a red-hot wire, and repeating this application once a fortnight or three weeks, until a cure is effected by their gradual contraction. This little operation is most conveniently effected by placing the patient in a kneeling posture, and then holding aside the posterior and lateral vaginal walls by means of curved copper spatulæ, when the opening will be fairly brought into view.

When the fistula is larger, and especially when vesical, its cure can only be accomplished by paring the edges, and then bringing them together with sutures, and thus attempting to produce a permanent union. This is the first intention. In

effecting this, however, two difficulties present themselves—the either cutting their way out too soon, or the trickling of urine to freshly pared edges interfering with adhesion. In order to overcome these difficulties, a variety of ingenious contrivances have been introduced by different surgeons; amongst which may be especially mentioned those of Dr. Marion Sims and Baker Brown, and the button-suture of Mr. To Sims especially is due the great merit of having substituted catgut for silk sutures in this operation, by which the probabilities of a successful result have been very greatly increased.

Before the operation, the bowels should have been freely opened by oil and an enema. No chloroform should be given, as its administration interferes with the position that the patient must maintain during the operation. This should be on the knees and elbows, on a narrow table, the buttocks well raised and the head low. It is of great moment that the parts should be freely exposed. This is best done by means of the "billed" speculum, by which the posterior wall of the vagina is turned up and out of the way of the operator, and light is reflected on the opening. The edges of the aperture are now to be freely pared, best done by seizing them with a hook forceps or a double-pointed dissecting off the vaginal mucous membrane to the extent of a quarter of an inch all round, by means of a fine small scalpel or pair of knives and scissors properly curved. The dissection should be towards the fissure, and especial care taken that the angles are freed of mucous membrane.

After the edges of the fistula have been freely pared, and all cicatricial constrictions divided, sutures of silver or annealed iron (which does not rust) are passed across the lips of the wound. These are most conveniently passed by means of the hollow needle, or, if not at hand, a silk thread may be passed by means of a narrow needle, a full half inch from the freshened edge of the fistula, and drawn out through a corresponding point on the other side of the vagina, having transixed the mucous membrane of the bladder. As many as necessary having been passed in this way, a piece of silver wire eighteen inches long is attached to the silk, which is then drawn out of the wire to occupy its place, so that its centre corresponds to the middle of the fistula, both ends hang out of the vagina. Dr. Sims then passes the upper ends through holes made in a narrow leaden bar, on which they are held by having split shot fixed upon them in the same way as is done in the inguinal case. The unclamped wires are now drawn down until the shot is close to the upper suture holes; and a second clamp is then fixed on the lower ends and is pushed up against the lower suture apertures. In this position the edges of the fistula are brought and held together on each side by the shot, which may be allowed to remain in from seven to ten days. It may then be removed by clipping off the flattened shots from the one, which is thus detached from its bed. The posterior one, with the shot attached, may then be hooked up, pushed backwards, and lifted out of the vagina with forceps. Instead of a clamp Dr. Simpson uses a spiral annealed iron wire, which surrounds and supports the tissues of the fistula. In many cases, however, where the fistula is of but small size, the clamp and splint may be dispensed with, and the edges of the fistula brought together with the suture wires only.

In the after-treatment, especial attention is required, and the first point is to prevent the contact of the urine with the edges of the wound. With this view a catheter should be introduced, and worn in the

that no urine may collect in this organ. For this purpose, Sims has invented a very ingenious catheter, represented in the annexed cut (Fig. 488), which may be worn with more comfort, and with less chance of slipping, than the ordinary instrument. After the patient has been put to bed, and the catheter introduced, a full opiate should be given, and continued throughout the treatment, with a view of preventing the action of the bowels, a point on which Sims lays much stress, and to which the success of his operations may be in a great measure attributed. It is very seldom that they are required to be opened for ten or fifteen days, provided the patient be kept on a rigid diet. During this treatment the catheter may be removed once or twice a day, in order to be cleansed and to be kept free from phosphatic or mucous accumulations; and free ablutions of the external genitals by sponge or syringe and warm water should be practised during the whole of the treatment. After the removal of the sutures, Sims advises that the catheter should be continued, and great care taken that the patient do not move too soon, lest the weak cicatrix be strained.



Fig. 488.—Sims's Catheter

More recently, a very simple and successful mode of closing these fistulæ has been invented by Dr. Bozeman, (the application of which that gentleman gave us an opportunity of witnessing during a visit to this country,) by what he terms the "button-suture." After paring the edges of the fistula, and passing silver wires across in the usual way, he draws the parts together by passing both ends of the wire through an aperture in a steel rod, which being carried along them closes the opening. A thin leaden plate, "the button," properly perforated down the middle, is then slipped along the wires so as to cover the fistula (Fig. 489); and split shot having been pushed along, their free extremities are pressed tightly against the button, the wires are then properly nipped, and the apparatus left on



Fig. 489.



Fig. 490.

Bozeman's Apparatus for Button Suture.

for about ten days (Fig. 490); the shot are then cut off, the leaden plate carefully lifted off, and the suture wires, having been straightened out, are withdrawn.

Whatever kind of suture is employed, it is always of great importance that the edges of the fistula be brought together *transversely* to the long axis of the vagina. Should the abnormal aperture be close to, or even implicate, the cervix uteri, this part may be drawn down and transfixed with the sutures, thus adding materially to the support of the posterior lip of the fissure.

TUMOURS OF THE URETHRA.

Small *Polypoid Tumours* are not unfrequently met with inside the urethral orifice. They have occasionally a gonorrheal origin, though they commonly arise irrespectively of such disease. They are always very vascular,

and are most frequently met with in or around the female urethra; they are of a bright red colour, have a florid hue, bleed freely, and are composed of a spongy kind of erectile tissue; they are conoidal or oval, encircling the urethral orifice on one side, or a complete zone around it. They grow slowly, and seldom increase in size than that of a raspberry. They are not unfrequently the result of a vast deal of sympathetic irritation, great pain in micturition, an admixture of mucus or pus in the urine, uneasiness of the back, the abdomen, and often aching in the loins.

These vascular tumours are far less frequent in the male urethra. When they occur in men, they usually consist of a granular florid mass inside the orifice of the canal.

When seated in or around the female urethra, these tumours frequently give rise to very great and continuous irritation; and after passing urine, radiating through the whole pelvic region, many of the symptoms of stone; so that patients labouring with this affection are often sounded on the supposition of the existence of a stone.

TREATMENT.—Vascular urethral tumours may be removed—by Excision, Ligature, Caustics, or the Actual Cautery.

1. *Excision.* When situated within the male urethra, the tumour may be snipped off by a fine pair of curved scissors. When situated in or around the female urethra, if of small size and pedunculated, it may be removed by the scissors or dissected away; the urethra being encroached on as little as possible. This operation is, however, always attended or followed by very considerable hæmorrhage, which has even, in some instances, proved fatal. Hence, when the tumour is large and the patient is young, the operation should be practised with much caution. If it be done, the hæmorrhage may be arrested by the introduction of a catheter into the urethra, and the firm pressure on the bleeding surface by means of a pad of lint held in place by a T-bandage.

2. *Ligature* is not a convenient mode of removing these tumours; its application is difficult, very painful, and tedious.

3. *Caustics*, particularly strong nitric acid or potassa cum aqua, may be very conveniently employed where the tumour is of small size and is vascular. In applying them, the upper wall of the canal may be protected by a broad director introduced along it.

4. The *Actual Cautery* is the most convenient agent for removing vascular tumours from the female urethra. By it they are removed without hæmorrhage; and the eschar that is formed protects the raw surface from the irritation of the urine. If they be situated within the urethra, and of small size, the galvanic cautery, applied by a wire, will most easily reach them; but if they be at or around the orifice, always employ a small olive-shaped cautery. During its use the surrounding parts must be protected from the action of heat by the introduction of the urethra by a director or silver catheter, which should be held in place by a T-bandage during the operation.

CHAPTER LXX.

DISEASES OF THE PENIS AND SCROTUM.

DISEASES OF THE PENIS.

HYPOSPADIAS.—It occasionally happens that there is an arrest of union in the mesial line of the penis, so that a slit or fissure is left communicating with the urethra. This gap commonly occurs on the under surface of the organ, constituting *hypospadias*, and is confined to the glans and upper part of the penis; though it occasionally extends backwards to the root of the organ, and may then be associated with some of those kinds of malformation that are erroneously considered as examples of hermaphroditism. These conditions are mostly incurable, though plastic proceedings have occasionally been devised for their relief.

EPISPADIAS.—The upper surface of the penis is less frequently fissured; only, I believe, in cases of extroversion of the bladder. This condition, termed *epispadias*, may be looked upon as incurable.

PHIMOSIS.—The prepuce is not unfrequently the seat of malformation or disease. That condition of it in which it is so much elongated that it extends beyond the glans, and at the same time is so much contracted that it prevents the proper exposure of this portion of the organ, is termed *phimosis*. This may be either congenital, or acquired as the result of inflammation or disease.

In *Congenital Phimosis*, the penis is usually somewhat atrophied, and the development of the glans is prevented by the pressure of the narrow prepuce. In congenital phimosis the skin is usually abundant and lax; but the mucous lining of the prepuce is short, contracted, and undeveloped. It is in this situation, and not in the skin, that the congenital defect is situated. In the majority of cases this condition is simply a source of inconvenience; but it may become a cause of disease from the retention of the sebaceous secretion of the part setting up irritation and repeated attacks of inflammation (Fig. 491). In some cases the preputial orifice is so tight as to interfere materially with the discharge of the urine; and irritability of the bladder, often presenting symptoms simulating calculus, may thus be set up. At a more advanced period of life I have known it a cause of impotence, or rather interfering with conception in the wife, by the semen after emission being retained under the tight and narrow prepuce until erection had completely subsided. Congenital phimosis especially becomes a source of inconvenience in after-life if any gonorrhoeal or venereal disease be contracted, as it renders the exposure of the diseased part difficult or impossible, and interferes with the necessary treatment.

Acquired Phimosis usually results from repeated attacks of inflammation, or of specific disease in the part, giving rise to solid ordema, or to false hypertrophy of the prepuce.

Treatment.—Phimosis, when not congenital, must be treated in accordance with its cause: thus, if it have resulted from inflammation, that must be subdued; if from venereal disease, that must be remedied, when perhaps the contraction and elongation will gradually subside. If, however, the phimosis

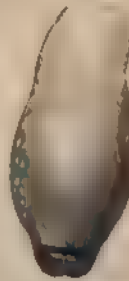


Fig. 491.—Congenital Phimosis.

be congenital, or if, though acquired, to operation; and, indeed, I think children should be operated upon, cleanliness of the parts in after-life.

Operations for phimosis may be performed, and contracted prepuce may be removed.

Slitting up of the Prepuce. This, I think, an objectionable operation, on account of the abnormal length, and more or less of the prepuce. I prefer circumcision as the simplest and the most satisfactory result.

Circumcision for Congenital Phimosis. This is most easily and safely performed when the child has several times had an opportunity of retracting the foreskin slightly forwards, and then, with an instrument of the kind



Fig 492.—Instrument for holding the Prepuce in Circumcision.

perpendicularly, and slightly forwards, the frænum of the prepuce is cut by one stroke of the mucous membrane with the thumb along the back so as to be the skin. A small organ in the middle of the mucous membrane is removed by its pressure. Union is perfected in the eighth day after



Fig 493.—Circumcision in the

front of that structure. He then makes an incision in front of the glans with a pair of scissors, and gives to an assistant, who must

the bistoury he cuts off all that portion of the integument which projects beyond the forceps, which are then taken away (Fig. 493). It will now be found that he has only removed a circle of skin, but that the mucous membrane lining it still tightly embraces the glans; this he slits up, by introducing the point of a pair of scissors at the preputial orifice; and then, trimming off the angles of the flaps of mucous membrane and snipping across the frenum, he turns back the mucous membrane, and attaches it to the edge of the cutaneous incision by five points of metallic suture, two on each side and one at the frenum. Before introducing these, he will generally find it necessary to ligature a small artery on each side of the penis, and one or two in the frenum. Union readily takes place by simple dressing; and a very narrow line of cicatrix is left, by which the patient is by no means inconvenienced. In some cases I have found adhesions between the prepuce and the glans; these require to be dissected through, but no inconvenience results from this slight addition to the operation.

If sloughing of the prepuce have occurred, allowing the glans to protrude, as in Fig. 494, circumcision must be practised.

PARAPHIMOSIS—In *paraphimosis* the prepuce has been forcibly drawn back behind the glans, which becomes strangled by the pressure exercised by the preputial orifice, so that the parts cannot be replaced in proper relation to one another. This accident principally occurs in boys, or in individuals who have naturally a tight prepuce, and who, on uncovering the glans, find it difficult to get this part of the organ back. This difficulty is speedily and greatly increased by the swelling from congestion that is set up in the constricted glans.

Treatment.—This is sufficiently simple. The surgeon should first try to reduce the swollen organ. He may often succeed in doing this by seizing the body of the penis between the index and middle fingers of each hand, and then endeavouring to draw the prepuce forwards, at the same time that he compresses the glans between the two thumbs and pushes it back (Fig. 495). Should reduction not be effected in this way, the constricted and strangulating preputial orifice must be divided. In doing this, the surgeon will observe that the glans is separated from the body of the penis by a deep and narrow sulcus, which is especially evident on the upper part of the organ. This sulcus, which is overlapped on one side by the glans and on the other by a fold of integument, corresponds to the inner margin of the preputial orifice; and it is by the division of this, in which the stricture is situated, that immediate relief will be given. This operation may readily be done by drawing the glans forwards, then passing the point of a narrow-bladed scalpel into the sulcus on the dorsum of the penis, and making a perpendicular incision about one-third of an inch in length through the integuments at the bottom



Fig. 494.—Sloughing of the Prepuce, and Protrusion of the Glans.



Fig. 495.—Reduction of Paraphimosis

of the groove directly across it (Fig. 496). In consequence of stretching of the parts, the incision will immediately gape with

instead of being longitudinal, it will be transverse; and then reduction of the parts will readily be effected.



Fig. 496.—Incision in Operation for Paraphimosis.

and smarting, together with muco-purulent discharge.

Treatment.—The disease requires to be treated on ordinary principles. The continued application of lead lotion, with administration of salines, will generally remove it; but in the most effectual plan will be found to consist in rapidly inflamed surfaces with a stick of nitrate of silver passed down on one side of the frenum, and carried round to the opposite side.

HERPES OF THE GLANS AND PREPUCE is characterised by the small vesicles or excoriated points upon the mucous membrane attended by much smarting and itching, and chiefly occurring in a gouty habit of body, with an irritable mucous membrane.

Treatment.—This slight affliction is often very rebellious. In many instances local means alone will not suffice; for relief may be obtained by powdering the part with the oxide of zinc, or slightly astringent and cooling lotions, yet no permanent cure is derived unless constitutional irritation be removed by the cooling or alterative character, modified according to the character of the case.

HYPERTROPHY OF THE PREPUCE not unfrequently occurs

of chronic irritation or disease; in a limited extent, and requires no special treatment on the part of the surgeon; but in some instances it may become so extensive as to require operative interference. Thus Virchow and figured a case that had attained enormous size, that the organ reached the knee, and was as large as a thigh; the enormous growth was successfully excised.

WARTS on the penis have also been described. They may attain a very large size (Fig. 497), and are best treated by removal with curved scissors.

Fig. 497.—Warts on the Penis.

CANCER OF THE PENIS is of two kinds, occurring as Scirrhus or as Epithelioma. The cancer assumes the Scirrhus form, and springs from the sulcus behind the glans, and may thence invade the neighbouring portion of the organ. It may assume the primary form of tubercle or of infiltrated cancer of the glans. It has been supposed, without much show of reason, that congenital phimosis predisposes to cancer, probably by confining the secretions, and thus keeping up an

part. Hey found that, of 12 patients with this disease who came under his observation, 9 had congenital phimosis; and Travers states that Jews, who are circumcised, are seldom subject to this affection. But as they are a limited community in this country, and as the disease is rare, we cannot draw any conclusive inference from this observation. It is, I think, very probable that the epithelial form of the disease may arise from the local irritation resulting from congenital phimosis. The scirrhus form of the affection, however, can occur in individuals who have not suffered from phimosis; of this we have had several instances at the University College Hospital.

Epithelioma, commencing as a tubercle in the prepuce, may, after a time, give rise to a large irregular and sprouting mass, having a granular fungous appearance, bleeding with much fetid discharge, growing rapidly, enveloping and at last implicating the glans (Fig. 498). In other cases it commences as a hard scirrhus mass of a pale reddish-white colour, situated on the glans, or between the prepuce and the glans. This increases in size, at last cracks, and allows a serous fetid discharge to exude. Ulceration then rapidly takes place. Sometimes the disease appears to be very distinctly localised; but after its removal it will always present the character of infiltrated cancer. It is, I believe, always primarily situated at the anterior extremity of the penis, not occurring in the body of the organ except as a secondary deposit.



Fig. 498. Epithelioma of the Penis.

Diagnosis.—*Epithelioma* of the penis requires to be diagnosed from *fungoid warts*. This may usually be done readily enough, by comparing the indurated state of the malignant with the soft and lax condition of the non-malignant affection. From *chancreous induration* of the glans, the history of the case and the way in which it is influenced by treatment will enable the surgeon to effect the diagnosis of scirrhus. In indurated plastic effusions into the corpus spongiosum, no pain is experienced, and the disease remains in a stationary condition.

Treatment.—The treatment of cancer of the penis will vary according to the nature and extent of the malignant affection.

In the *Epithelial* form of the disease the surgeon may, if he see the case early, whilst the morbid growth is small and limited to the prepuce, content himself with dissecting off the affected patch. Should the epithelioma, however, have attained a large size (Fig. 498), and more particularly if it have implicated the glans, then amputation of the organ is indicated.

The treatment of *Scirrhus* of the penis must be conducted on the principles that guide us in the management of malignant affections wherever situated: viz., to remove the diseased organ at as early a stage as possible whilst the affection is localised, before the glands are implicated and the constitution poisoned. In the penis, this may readily be done by an operation that is simple in its execution and devoid of danger. In many cases, more especially of scirrhus, a return may take place, and that speedily, either in the part itself or in the neighbouring lymphatic glands; yet, even if this occur, it is clearly the duty of the surgeon to rid the patient of a loathsome disease, and to put him in a state of comparative comfort for some months; the more so, as there can be no doubt that, in some instances, the disease may be entirely extirpated from the system,

evinced no tendency to return. Indeed, I believe that amputation for cancer is more successful in its results than the removal of malignant growths from most other situations. In the epithelial disease it is especially an useful operation. In some of Hey's cases continued under his observation, there was no recurrence of the disease several years. I have seen several patients who, after a lapse of years, continued free from a recurrence of the disease; and I have known a gentleman who had his penis amputated for cancer more than twenty years ago, and in whom no return has taken place. The fact is, that in the great majority of those cases in which a recurrence takes place, but those who remain free from a return of the affection do not divulge their cure. It is exceedingly rare in hospital practice to find a patient with recurrent cancer in the stump of the penis, which he would not have if relapse took place. In those cases in which the operation is not performed, it has usually been delayed too long, the disease having already invaded the lymphatic glands in the groin, and thus contaminated the constitution.

Amputation of the Penis may be practised either with the *écraseur*. Whichever instrument is used, the operation should be performed towards the root of the organ, so as to be well above the disease; at the same time, care must be taken not to remove too near the pubes, lest the stump retract under that bone. Division with the knife may readily be done by the surgeon, and the penis upon the stretch, drawing the integument well forward, severing the organ at one stroke of the bistoury. As the corpus cavernosum retract more than the integument, it is well not to leave too much of the flap, falling over the face of the stump, make the search for the internal vessels somewhat difficult, and afterwards pucker inconvenient. Hemorrhage during the operation may be effectually restrained by a narrow tape tightly round the root of the penis. There are three arteries requiring ligature: the dorsales penis, one in each corpus cavernosum, and one in the septum. In securing these, trouble is not experienced in consequence of the retraction of the stump that is liable to this, however, is lessened by tying a tape round the organ before the operation is commenced, or by directing the hand to hold it firmly between the fingers, and thus to prevent the retraction of the stump, which may otherwise draw back and be buried under the skin almost in the perineum. Should it do so, and oozing continue, a catheter must be passed into the urethra, and a firm compress applied. **T-bandage.** During and after cicatrization, the urethral orifice is liable to contract. The liability to this may, however, be lessened by drawing forwards the mucous membrane, making four cuts in it with the scissors, and then stitching it to the edge of the cut skin. If the operation be performed high up, this may be somewhat difficult, and then it is safer to introduce an elastic catheter before the operation, to prevent retraction upon and through this, and to leave it in during cicatrization. When the *écraseur* is used, the skin should similarly be drawn forward, the instrument worked slowly, so as to divide the organ without hemorrhage.

After amputation of the penis, the urine will not be projected, but always passes directly downwards between the legs. An inconvenience in this respect may best be avoided by adopting Ambroise Paré's advice of adapting a funnel, which may be made of metal or wood, and placing it over the pubes over the stump, and thus carrying the urine clear of the perineum.

Other tumours besides cancers are occasionally met with in the penis. I have seen *Necus* situated under the prepuce (p. 689), and *Fibro-plastic Tumour* of this structure extending into the corpus cavernosum. Such morbid growths usually admit of removal without sacrificing the whole organ.

DISEASES OF THE SCROTUM.

INFLAMMATORY OEDEMA of the scrotum is an erysipelatous inflammation of this region, which derives its chief peculiarity from the circumstance of its giving rise to great effusion into and swelling of the cellular tissue, with a tendency to the rapid formation of slough in it, by which the integument may likewise become affected to such an extent that the testes and cords speedily become denuded. This disease usually originates from some local source of irritation, as fissures, cracks, or urinary extravasation (p. 456).

Treatment.—This consists in elevating the scrotum, fomenting it well, and making early and free incisions into it, particularly at the posterior and dependent parts, with the view of relieving the tension to which the tissue is subjected by the effusion into its cells, and thus preventing the liability to slough. Should this occur, the case must be treated on ordinary principles, when cicatrization will speedily ensue, however extensive the denudation of parts may be. The constitutional management must always be conducted in accordance with those principles laid down in the first division of this work, and with especial attention to the maintenance of the patient's strength.

HYPERTROPHY of the scrotum seldom occurs in this country, though Liston once had occasion to remove such a mass, weighing 44 lbs.; but in some tropical regions, particularly India and China, it is of frequent occurrence, and may go on until it attain an enormous bulk, forming a tumour nearly as large as the trunk, and perhaps weighing 60 or 70 lbs. These enormous growths are of a simple character, and constitute the disease termed *Elephantiasis of the Scrotum*. Fig. 499 represents a tumour of this kind, weighing 40 lbs., which was successfully removed by Dr. Rogers of the Mauritius. It is taken from a photograph of the case, kindly sent to me by that gentleman.

Treatment.—Tumours of this kind necessarily require extirpation. In performing such operations there are two points that demand special attention: the first is to preserve the penis and testes if possible, which will usually be found buried towards the upper part of the mass, and which may be saved if the tumour be of small size; and the second is, to endeavour to prevent the hemorrhage from being too profuse. With this view, the operation ought not only to be performed as rapidly as



Fig. 499.—Elephantiasis of the Scrotum.

possible, but the suggestion made by O'Ferrall of elevating above the level of the body, for some time before its removal, empty it of its blood, may be advantageously adopted. If very large, it will be better not to make any attempt at saving the penis, which could only be dissected out by a long and tedious course of which there would be danger of the patient dying from exhaustion.

CANCEROUS OR CANCROID DISEASE occasionally affects the scrotum. If it principally occurs in chimney-sweepers, it has been aptly termed *Chimney-sweeper's Cancer*. This affection appears to be an irritation of the soot lodging in the folds of the scrotum, the common form of canceroid disease. It commonly commences as a wart, which at last tends to crack or ulcerate, presenting characters of cancerous ulceration. After a time, the inguinal glands will be seen to be affected; and the patient, if the disease is extensive, will be found to be cachectic-looking.

The *Treatment* consists in excising widely the diseased scrotum, provided the inguinal glands be not involved, and the constitution poisoned. The disease has a great tendency to recur, and is seldom that the patient long escapes with life when once affected by it.

CHAPTER LXXI.

DISEASES OF THE TESTIS AND CORD.

MALPOSITION OF THE TESTIS.

THE testes are, in the foetus, contained within the abdominal cavity. In the normal condition descend into the scrotum a short time before birth. In some cases, some arrest of development this descent may be retarded or altogether prevented; and in other instances it never takes place. An undescended testis may continue to lie within the cavity of the abdomen; or it may descend into the internal ring; or may become engaged in the inguinal canal above the external abdominal ring. In these several situations the testis may be quiescent; but it may become the seat of inflammation or of cancerous degeneration, simple or malignant. It may also, when undescended, become stated at p. 1009, become complicated with a hernia, and may present great diagnostic difficulties. Inflammation of the testis retained in the abdomen may be considered at p. 1203. When an undescended testis is the seat of structural degeneration, it may require removal from the body. In the testis may be met with in other abnormal situations; thus, I saw a case in which one of these organs was situated in the pelvis, close by the anus, having apparently missed the scrotum; and another occurred in which they have been met with in the interior of the thorax. The organ may sometimes be turned hindsid forward, but so that the epididymis is placed in front. In a case of this kind, I had an opportunity of examining after death a few years after the patient's death. The epididymis and vas deferens were considerably larger than natural, and in such a case, it will be seated behind the testis.

There is a very important question connected with mal-

testis, viz. : Is the organ when undescended prolific ? There is reason to believe that it is not. Such testes are small, hard, and granular in structure ; and when they are examined under the microscope, spermatozoa are not found in them. When only one testis is undescended, the other one, being in its proper position, carries on the functions of the two organs ; but when both testes are retained in the canal or in the abdomen, being undescended, the individual who is the subject of such malposition will most probably be sterile. He may have the usual erotic feelings, full power of erection, and of emission of a spermatic fluid ; but the secretion will have no fecundating power.

NEURALGIA OF THE TESTIS.

A painful or irritable condition of the testicle may occur without any actual disease of the organ ; the pain being either seated in the epididymis, which is the part naturally the most tender, in the body of the testis, or stretching along the cord to the loins and groins. It is usually paroxysmal, and is accompanied by great tenderness, and commonly by some fulness of the organ, which feels soft and flaccid ; but it is difficult to make a proper examination, on account of the agony that is induced by touching the part. This disease chiefly occurs in young men of a nervous and excitable temperament, and is frequently associated with great mental disquietude and despondency, often amounting to a suicidal tendency.

The *Causes* are obscure ; in many cases the disease appears to be connected with a neuralgic temperament, but in others it is associated with some dyspeptic disorder, or may be dependent upon local irritation ; thus external piles, or the pressure of a varicocele, will often give rise to it.

The disease is usually of a very chronic character. In some instances, however, it ceases spontaneously, after having lasted for weeks or months.

Treatment.—When the neuralgia is dependent upon constitutional causes, the treatment is extremely unsatisfactory. The administration of tonics, such as iron, zinc, or quinine, the local application of sedatives, as of atropine ointment, or the tincture of aconite, may be of service. In other cases, cold bathing or douching will be beneficial ; and, in all, keeping the part supported with a suspensory bandage will be advantageous. In the event of there being any local irritation, that should be removed ; thus I have known the disease to cease after the excision of external piles ; and when it is connected with varicocele, proper measures must be adopted for the relief of that affection. In extreme cases, Sir A. Cooper recommends castration ; but such a proceeding is altogether unjustifiable in a disease that is either constitutional, or dependent on local causes which are readily removable.

INFLAMMATION OF THE TESTIS.

Inflammation of the Testicle, considering the organ as a whole, may be of two distinct kinds, varying as to seat and as to cause. Thus it may be seated in the body of the organ, constituting *Orchitis* ; or the epididymis may alone be affected, constituting *Epididymitis*. As to cause, it may be rheumatic, traumatic, or gonorrhoeal.

ACUTE INFLAMMATION.—The *Seat* of the inflammation, at the commencement of the disease, depends greatly upon its cause, which may be in the urinary passages or elsewhere. Irritation in any part of the urethra, occasioned by the passage of instruments, by the lodgment of calculi, or by gonorrhoeal inflammation, usually causes the epididymis to be primarily affected, and the body of the organ to be inflamed in a secondary manner. When, on the other hand, the inflammation comes on from injuries, blows,

strains, or other causes acting generally, the body of the testis first affected. To all this, however, exceptions will often occur; may supervene as the result of gonorrhoea, or epididymitis from orchitis in such cases is in all probability a kind of constitutional inflammation intimately associated with inflammation of other fibrous tissues with gonorrhoeal rheumatism; the inflammation of the epididymis from gonorrhoea or other irritation of the urinary passages, a result from direct extension of morbid action along the vas deferens.

SYMPTOMS.—These necessarily vary to a certain extent, not only as the disease is of an acute or a chronic character, but as it attacks the body of the testis or the epididymia. When it commences in the body of the testis, it is the inferior globus that is commonly first affected, which is swollen, hard, and tender. The disease may be confined to this part; but most frequently it invades the whole of the organ, which is uniformly enlarged and somewhat ovoid; it is frequently accompanied by a good deal of effusion into the tunica vaginalis, then constituting a *Hydrocele of Velpeau*. As the inflammation subsides, the difference is presented by the enlargement of the two constituents of the organ is no longer apparent. The swelling is therefore due partly to general enlargement of the organ, but in some cases to inflammatory effusion into the tunica vaginalis, and this may either be of a purely serous, or partly of a plastic nature.

The pain is always very severe, with much tenderness and a heavy weight, and commonly extends up the cord into the groin and is generally greatest when the body of the testis is affected, owing to the enveloping fibrous tunic preventing the expansion of the organ. It is often spasmodic and paroxysmal, extending up the course of the cord. There are usually considerable swelling and redness of the scrotum, a tumescence of the scrotal veins, and a congested state of the system, with sharp pyrexia, nausea, and perhaps occasional vomiting.

As the disease subsides, the body of the testis first resumes its normal character and shape, the epididymis often continuing hardened at first for a considerable period. In fact, the induration that forms in the epididymis may become somewhat permanent, owing to the effusion of matter into it, leaving a hardened mass, and implicating the whole of its convolutions.

SUBACUTE ORCHITIS usually comes on with the same symptoms, but in a less marked form than in the acute variety. The swelling is considerable, though of a softer kind. When the disease is of the chronic type, the testis often becomes permanently enlarged and hardened, assumes an irregular shape, being smooth, heavy, and uniformly expanded, with a great weight, dragging and severe pain, and a good deal of tenderness. This form of orchitis occasionally occurs in old people.

TREATMENT.—The treatment of *Acutely Inflamed Testicle*, whether constitutional, is essentially antiphlogistic. Blood should be abstracted from the part by puncturing the veins of the scrotum—a far better method than applying leeches, the bites of which are apt to become irritated. The operation may be very effectually done by directing the patient to lie on his back and to foment the scrotum for a few minutes with a hot spirit, which will distend the veins; these may then be punctured at various points with a fine lancet, and the parts well fomented afterwards, so as to ensure a free flow of blood. In this way six or eight ounces may be taken in the course of a few minutes; when enough has escaped, the further flow may be arrested by laying the patient down and elevating the part.

The patient should be kept in bed with the testis raised on a support.

between the thighs, poppy fomentations being diligently applied. If there be much effusion into the tunica vaginalis, constituting acute hydrocele, relief may be afforded by puncturing this sac with the point of the lancet.

The *Constitutional Treatment* during the acute stage consists in the administration of salines and antimony, with henbane in full doses, so as to give an aperient, a diaphoretic, and a sedative together; when this begins to act, great relief is usually afforded.

As the inflammation subsides, the treatment must be changed. When there is merely swelling and hardness left, with but little pain or tenderness, the testis may advantageously be strapped with adhesive plaster, so as to give good support and to promote absorption of plastic matter. Fricke of Hamburg has strongly recommended strapping in the acute stage; but I cannot say that I have ever seen any advantage derived from it at this period of the disease, though I have many times seen it tried; it has usually appeared to me to increase, sometimes very considerably, the pain in the part and the general uneasiness.

In *Subacute Orchitis* much benefit is usually derived from a short course of Dover's powder and calomel, with early strapping of the testis. When the organ has become enlarged and indurated, as the result of chronic inflammation, it may be advantageously strapped, either with simple plaster, or with one composed of equal parts of the emplastrum ammoniaci cum hydrargyro and soap-plaster; mercury in small doses, more especially the bichloride, being continued for some length of time, until the plastic matter is absorbed and the hardness disappears.

In *Strapping a Testicle*, the scrotum should be shaved, and then drawn tightly upwards on the affected side. The surgeon should next pass a long strip of plaster, about an inch broad, above the enlarged testicle and round the corresponding side of the scrotum, so as to isolate it, as it were. Another strip is now passed from behind, in a longitudinal direction, over the lower end of the testis, and upwards upon the anterior part of the scrotum: and thus, by a succession of horizontal and vertical strips, neatly overlapping and drawn tightly, the organ is completely enveloped and compressed. To be of any service, the strapping must be tightly and evenly applied; but at the same time care must be taken not to strangle the scrotum by drawing down the upper strips of plaster too forcibly. In a case of "tuberculo-syphilitic" disease of the testis, in which I was obliged to have recourse to castration, the whole of the side of the scrotum had sloughed away, leaving the testis exposed and fungating, in consequence of the tight strapping which had been employed before the case came into my hands.

ABSCESS, as the result of inflammation of the testis, is of rare occurrence: sometimes, however, the scrotum inflames at one point, where fluctuation becomes apparent, with thinned skin and evident signs of suppuration; a puncture should here be made, and the pus let out as soon as formed. Sometimes abscess may occur in another way: inflammation is set up in the tunica albuginea, adhesion takes place between the testis and the scrotum, abscess forms under the fibrous coat, and, this giving way, the pus gets vent externally through the integuments. Into the aperture that necessarily results, a portion of the secreting tissue of the gland sometimes projects, and, becoming inflamed, forms a red, granular, and fungous mass, protruding through and overlapping the edges of the aperture. The treatment of this condition will be considered when we come to speak of the scrofulous testicle.

INFLAMMATION OF THE TESTIS IN THE INGUINAL CANAL may sometimes take place, even in adults, when the organ has not descended through the external ring; giving rise to a train of somewhat puzzling symptoms which

closely resemble those of strangulated incomplete hernia ; with ever, it must be borne in mind that it may be associated (p. examination, a large irregular tumour, in some parts hard, is very tender to the touch, and occasioning a sickening sensation will be found in one of the groins, in the situation of the inguinal canal. There are usually a tendency to vomiting and some constipation of the bowels, and pains in the abdomen. These symptoms, however, are generally persistent, and the constipation readily yields to the administration of cathartics. On examining the scrotum, it will be found that the affected side is absent ; and, on passing the finger into the external inguinal ring, the testis can be felt to be lodged in the canal. In consequence of the proximity of the peritoneum to the inflamed testis, this membrane becomes involved in the morbid action ; and, as the result of the extension of the tendinous and aponeurotic tissues in this situation has occasionally occurred. Either of these conditions may lead to termination.

The *Treatment* should be actively antiphlogistic. Leeches applied over the part, and blood should be taken from the arm, if the patient be young and strong ; salines with antimony being at the same time administered, and fomentations diligently persevered in.

INFLAMMATION AND ABSCESS OF THE CORD.—In some cases inflammation of the testis may extend, or the disease may from the beginning be limited to, the cellular tissue of the cord, giving rise to tumour, and a good deal of pain and tenderness along it, and eventually accompanied by the usual signs of suppuration. The *Treatment* of such cases should be conducted on ordinary principles, early discharge for the pus being the object.

HYDROCELE AND HEMATOCELE.

By *Hydrocele* is meant an accumulation of serous fluid, formation with the testis or cord. Most frequently the fluid occupies the tunica vaginalis, constituting a true dropsy of it ; in other cases it appears to be formed in distinct cysts, situated either in connection with the testis, or upon the cord. Hence hydroceles are commonly divided into two classes, those that affect the *Tunica Vaginalis*, and the *Encysted* variety.

HYDROCELE OF THE TUNICA VAGINALIS may occur as the result of orchitis ; the inflammation of the testis causing the effusion of a limpid fluid into its serous investment. This, however, is not the most common variety of hydrocele that is commonly met with ; the fluid so poured out is the result of active inflammation, usually becoming absorbed as the part returns to its normal condition. The ordinary hydrocele occurs as a chronic disease, without any signs of inflammation of the testicle, or, at most, with a slight tenderness of that organ. It is most frequently met with in individuals in the middle period of life, and generally in persons of feeble power, or of a cachectic or gouty constitution, commonly without any evident cause.

In young infants, hydrocele is not unfrequently seen, and it affects two forms : either the ordinary one, similar to what occurs in adults, in whom the tunica vaginalis constitutes a closed sac filled with fluid ; or a less common variety, in which the accumulation of fluid in the tunica vaginalis communicates, by the persistence of a cavity or canal in the peritoneum, with the prolongation of the peritoneum investing the cord, with the general peritoneal cavity. This form of hydrocele is *Congenital* ; and it occupies the same position that intestine does in a congenital hernia. It may readily be recognised by the fluid being made to flow into the general peritoneal cavity, on raising or depressing the tumour.

this may be considered to be the true congenital form of hydrocele in infants, the other variety of the disease also occurs in them when but a few days old, and very possibly even at the time of birth.

Symptoms.—The symptoms of hydrocele are tolerably evident. The disease begins with a degree of swelling and weight about the testis: the swelling may at first be soft, but after a while becomes hard and tense; or it may be so from the commencement. Whatever its original condition, the tumour soon becomes oval or pyriform in shape, being narrowed above, rounded and broad below; it is smooth and uniformly tense and hard, often having a semi-elastic feel. It reaches upwards along the cord, towards the external abdominal ring, which, however, is never invaded by it, and the cord is usually distinctly to be felt above the upper margin of the tumour. Most commonly the size varies from that of a hen's egg to a small coco-nut; but sometimes it may attain a considerably greater magnitude than this, and will then cause much deformity of the parts, as it reaches up close to the external ring, and drags over the penis, causing that organ to be buried in it.

The most characteristic sign of hydrocele is its translucency by transmitted light. This may always be detected, by the surgeon grasping the posterior part of the tumour with one hand, so as to put the integuments of the fore part on the stretch, then placing the edge of the other hand along the most prominent part of the swelling, and having a lighted candle held close behind. On making this examination, the tumour will appear translucent; if, however, the walls of the sac be thick, or the fluid dark, the transmission of light through it may not be perceived unless the examination be conducted in a darkened room.

We have already seen that the ordinary hydrocele of the tunica vaginalis may vary as to size: it may also differ as to shape; in some cases being globular, in others constricted in the middle, or of an hour-glass shape.



Fig. 500.—Hydrocele.



Fig. 501.—Dissection of a Hydrocele, showing its coverings.

The quantity of liquid varies considerably; there is usually from six to twelve or twenty ounces, but I have known a hydrocele to contain more than

one hundred and twenty ounces. The fluid is generally clear and of a straw colour ; but in very large and old hydroceles of a dark-brownish or chocolate hue, owing to the admixture of blood ; and will then be found to contain flakes of cholesterol usually thin ; but in some old cases it becomes thick and of a kind of false membrane, and divided by septa or bands, to an extent as almost to separate it into distinct compartments. If the sac is thick, and the fluid opaque and turbid, there may be difficulty in detecting the translucency.

The testis is generally somewhat enlarged, especially about the time of the complaint, and frequently slightly tender, more particularly in the early stages of the complaint. It is almost invariably situated at the posterior pole (Fig. 500), but may sometimes be found towards its anterior pole ; in this case, the epididymis will be found turned towards the organ being retroverted.

The Coverings of a hydrocele are the same as those of the testis. The integumental structures, aponeurotic prolongations from the columnar and cremasteric fasciæ may be traced over the swelling (Fig. 501).

Treatment.—The treatment of hydrocele is divided into the curative. By the palliative treatment the surgeon simply relieves the patient of the annoyance induced by the bulk or weight of the swelling, but the curative has for its object the permanent removal of the fluid.

The *Palliative Treatment* consists in the use of a suspensory band, or cooling lotion, or in tapping with a fine trochar. These measures may sometimes succeed in effecting a radical cure. The latter will happen that the application of evaporating and discutient remedies remove the effused fluid ; and indeed it is seldom that any other treatment than this is required in young children. The best purpose consists of one composed of ℥j of muriate of ammonium dissolved in ℥vj of water ; with this the scrotum should be wetted ; and, if there be a communication with the peritoneum, the band should be kept applied over the external ring. In adults it occasionally happens that simple tapping of the tumour has effected a radical cure. A gentleman from Cuba consulted me for a small hydrocele which had been forming for several months ; I tapped it with a fine trochar, and it discharged about five ounces of fluid. This was followed by a radical cure. This case bears out a remark made by Sir B. Brodie, that the force of simple tapping to produce a radical cure is more likely to succeed in the West Indians. I have, however, several times seen hydroceles recur after having been tapped a few times, without any other cause than the heat of the climate. This is amply proved by the fact that persons who had never been in hot climates. This anomaly is altogether, however, destitute of danger ; I have known an oedema of the scrotum from inflammatory oedema of the scrotum after being tapped. It usually happens that the hydrocele slowly forms again, attaining its former bulk at the end of about three months. When a congenital hydrocele is tapped, the sac soon fills again by drainage into it from the peritoneum, and, indeed, in such cases the fluid of an ascites has been removed by tapping the tunica vaginalis.

In tapping a hydrocele a few precautions are necessary, the patient should be placed on his back, to avoid puncturing one of the scrotal veins, or injuring the testis. In the majority of cases the testis is situated at the back of the swelling, and consequently altogether out of the way of the trochar, if the patient is placed as it should be, by the surgeon putting the anterior

hydrocele on the stretch by grasping it behind with his left hand, and then pushing the trochar into the lower part of its middle third in front, carrying the instrument at first directly backwards (Fig. 502 a), but, as soon as it has perforated the sac, directing its point upwards (Fig. 502, b). If the testicle have been found, on examination with a lighted candle, to be on the forepart of the tumour, where it may sometimes be felt as well as seen, the hydrocele should be tapped at the side or behind. Before using the trochar, it is well to see that the cannular fits closely round the neck of the stylet; and, above all, that the instrument has not become rusty by having been carelessly put aside after use on a previous occasion.

The Curative Treatment has for its object the excitation of a sufficient degree of inflammation in the tunica vaginalis to restore the lost balance between secretion and absorption; but it is not necessary that the serous cavity should be obliterated by adhesions between its opposite sides, though these not unfrequently take place. The means by which the surgeon sets up this inflammation are either the introduction of a small seton into the tunica vaginalis, or throwing a stimulating injection into that cavity after tapping it. Whichever plan is adopted, a certain amount of inflammation ought to be set up. This is always attended by considerable swelling of the testis, and by the effusion of a fresh quantity of fluid into the tunica vaginalis. As this is absorbed, the part gradually resumes its normal bulk, and the disease will probably not return.

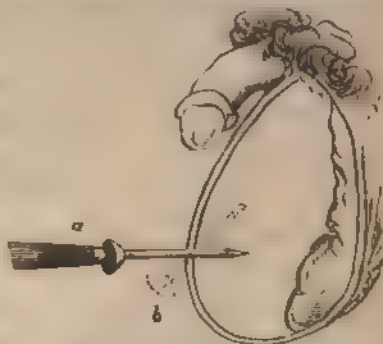


Fig. 502.—Tapping in Hydrocele: a, Introduction of Trochar, b, Position of Cannula.

In order that the radical cure, in whichever way undertaken, should be safe and efficient, it is necessary, in the first instance, that the disease should have been allowed to attain a chronic condition, more particularly if the hydrocele have been of rapid growth. In order to prevent its attaining too large a size, it will be well to adopt palliative tapping once or twice before attempting the radical cure. Care must also be taken to remove all inflammation and tenderness about the testis, before having recourse to this means of treatment. If attention be not paid to this, recurrence of the hydrocele will probably ensue. After the proper amount of inflammation has been set up, it will be well to treat the patient as if he were suffering under an ordinary attack of orchitis, confining him to bed or to the couch for a few days; indeed, I look upon care in the after-treatment as of very considerable importance in securing a favourable result to the case.

The cure by the introduction of a seton, though formerly much employed, is seldom practised at the present day, chiefly on account of the danger of exciting too much inflammation. It may, however, conveniently be employed in the true hydroceles of children, and in some of those cases in which the injection fails, if practised in the manner that will immediately be described.

The treatment by *Injection* is the one that is commonly employed; it consists in tapping the tumour in the usual way, and then throwing a sufficient quantity of stimulating fluid into the tunica vaginalis through the cannula, so as to excite a proper amount of inflammation in it. The liquids

that are employed are generally either port-wine, or a solution of zinc of the strength of $\mathfrak{z}\text{i}$ to $\mathfrak{z}\text{xij}$, or most commonly tincture of iodine. If the port-wine or a solution of the sulphate of zinc of sufficient quantity partly to distend the sac should be injected into an India-rubber bottle or brass syringe that can be adapted to the testis, or eight ounces are commonly required for this purpose, and allowed to remain in for some minutes before being evacuated.

Injection of Iodine ---The injection of tincture of iodine, introduced by Sir J. R. Martin, whilst practising at Calcutta, is preferred as a more certain and a safer mode of treatment. It is usually sufficient to inject about one or two drachms of tincture. It should be left in for a few minutes, in proportion to the amount of pain it occasions, and then allowed to escape. Inflammation will usually be set up, on the subsidence of which a cure will be found to have been effected.

Useful as the iodine injection is, it sometimes fails in producing a radical cure of hydrocele. This is attributable to two causes: the first, in some cases sufficient inflammation is not set up to induce the adhesion of the tunica vaginalis which is necessary for a radical cure. It is that, when a hydrocele is radically cured by injection, it is the adhesion taking place between the two opposite surfaces of the tunica vaginalis and a consequent obliteration of its cavity, but by the inflammation that is artificially induced exciting such a modification of the functions of the tunica vaginalis as to restore the balance between the secretion and absorption by which it is naturally lubricated. Now, in some cases, sufficient inflammation is not induced by the introduction of the irritating fluid, and the natural balance between these two functions of the membrane is not restored. The tunica vaginalis gradually fills again after the injection, as it would after a simple operation of tapping. It occasionally happens that the patient suffers excruciating agony at the time of the injection, from the stimulating fluid with the surface of the testis, and yet the inflammation may be excited. The amount of suffering, therefore, from the operation, is by no means proportionate to the amount of inflammation likely to be set up. Indeed, the reverse would be the case in many instances; and I have often observed that the progress of the cure, which progress most steadily to a radical cure, there is but a small amount of pain experienced at the time of the injection.

There is a second way in which injections would appear to fail. A considerable amount of inflammation is excited, and effusion takes place into the tunica vaginalis, which, in the course of three or four days, tends to the same size, or nearly so, that it had attained previous to the operation; but this effused fluid, instead of being absorbed, at the second or third week, remains unchanged in bulk, or absorbed to a certain point, and then seems to be arrested; the tumor remaining distended with a certain quantity of fluid.

The proportion of cases in which the iodine injection fails to produce a radical cure of the hydrocele is variously estimated by different authors. Thus Sir J. R. Martin states that in India the failures scarcely exceed 1 per cent.; Valpeau calculates them at 3 per cent. I am not aware of the statistics of this mode of treatment in this country have been collected. The general opinion of surgeons would appear to be decidedly in favor of it as being the most successful as well as the safest plan of treatment that has yet been introduced. In this opinion I fully coincide: it is by no means improbable that the success of the iodine injection

country might not prove to be quite so great as is generally believed. I have, during the last few years, seen a considerable number of cases of simple hydrocele of the tunica vaginalis, both in hospital and in private practice, in which a radical cure had not been effected, although recourse had been had to the iodine injection by some of the most careful and skilful surgeons of the day, as well as by myself.

One circumstance connected with the injection of tincture of iodine into the tunica vaginalis deserves note. It is that, although in some cases it occasions but little pain, in other instances the suffering induced by it is of the most severe and agonising character—more so than follows the introduction of any other of the ordinary stimulants into the tunica vaginalis.

Seton.—There can be no doubt that, as a first remedy, iodine injection is preferable to the seton, in the treatment of hydrocele; but when the injection has failed, and this from no want of care on the part of the surgeon, or of attention to the after-treatment of the case, but apparently from insufficient inflammatory action having been set up in the tunica vaginalis to restore the lost balance between secretion and absorption in this membrane, the seton will, I think, be found to be the most certain means of accomplishing our object. It is true that several objections may be urged to the use of the seton; it requires much watching and care, and is occasionally apt to excite a dangerous amount of inflammation in the cellular tissue of the scrotum; and these objections are, to my mind, sufficiently valid to prevent our employing it as the ordinary treatment for the radical cure of hydrocele. But it must be remembered, that the particular cases to which I am now alluding are those in which ordinary means have proved insufficient to excite proper action, and in which, consequently, it would appear as if a greater amount of irritation could safely be borne. Indeed, nothing is more remarkable than the difference in the intensity of the inflammation that is set up in different individuals by the means that are commonly employed in the treatment of hydrocele. In some cases the most irritating injections may be thrown into the tunica vaginalis, or a seton may be drawn through the scrotum and left there for days, not only without giving rise to any injurious inflammation, but without setting up sufficient action to bring about a cure of the disease; whilst in other instances simple tapping may effect a radical cure, or may give rise to such an amount of irritation as to terminate in fatal sloughing of the scrotum.

The seton that I employ in these cases is composed of one or two threads of dentist's silk. It may be introduced by means of a *nævus*-needle, the fluid of the hydrocele being allowed to drain away through the punctures thus made; or, far better, by tapping the hydrocele, and then passing a needle about six inches long, armed with the seton, up the cannula, drawing it through the upper part of the scrotum, and then removing the cannula, cutting off the needle, and knotting the thread loosely (Fig. 149). The thread should not be removed until the scrotum swells and becomes red, with some tenderness of the testis and effusion into the tunica vaginalis. When these effects have been produced, it may be cut and withdrawn, and the case treated in the same way as when the radical cure has been attempted by iodine injection; viz., by rest and antiphlogistic treatment. The length of time during which the seton must be left in before sufficient, or even any inflammatory action is produced, varies very considerably. In most instances, the proper amount of inflammation is excited in from twenty-four to thirty hours; but in other cases it may be left in for ten or twelve days, giving rise to but little inflammation, although a radical cure may result.

It is not always prudent to have recourse to the radical cure in the treat-

ment of hydrocele. In persons advanced in years, or of feeble constitution, the inflammatory action excited in the tunica vaginalis of the mens just detailed may run on to such an extent as to produce inflammatory oedema, and even sloughing of the scrotum, with death. In men advanced in years it is usually safer to treat a hydrocele, and only to tap as occasion arises from the increasing swelling.

ENCYSTED HYDROCELE.—In this variety of the disease the fluid lies in the tunica vaginalis, but is contained in a cyst which projects from the surface of the epididymis or testis, and pushes the serous investment of the gland before it.

These cysts are much more frequently found connected with the epididymis, than with the body of the testicle. Indeed, Curling has

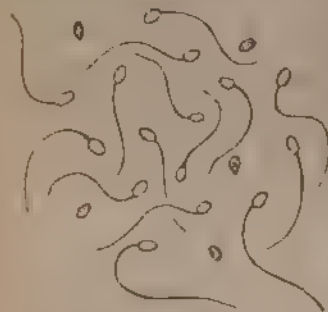


Fig. 503.—Spermatozoa from Encysted Hydrocele

observed the fact, that small peduncles, of about the size of currants, composed of a fine serous membrane, tessellated epithelium, are found beneath the visceral tunic covering the epididymis. These cysts, in structure, contain a fluid, and are very liable to rupture. They are met with at all ages after puberty. According to Gosse, at the age of forty, they occurred in one-third of the testes examined for their presence. Such cysts remain stationary, of small size, and are not to be detected during life,

unless by pathological phenomena; they may rupture into the tunica vaginalis, or they may enlarge and become developed into tumours of considerable magnitude.

The fluid of these cysts possesses the remarkable characteristic, observed by Leston, of containing spermatozoa (Fig. 503); an observation has been fully confirmed by many subsequent observers. The spermatozoa do not always exist in this fluid, yet they are usually met with in small quantities, at others so abundantly as to give an opalescent appearance. This admixture of spermatozoa with the fluid of the cyst is probably due, as pointed out by Curling, to the rupture of a seminal duct into an already existing cyst. Spermatozoa are also, but very rarely, been found in the fluid of an ordinary hydrocele of the tunica vaginalis; and then probably their presence was due to the rupture of one of these cysts into the tunica vaginalis. Hence the presence of spermatozoa in the fluid of a hydrocele may in most cases be considered as characteristic of the encysted variety of the disease.

The *Symptoms* of encysted hydrocele differ in some respects from those presented by the ordinary form of the disease. The tumour of this variety is smaller, more irregular in shape, and does not envelope the testis completely, but is situated behind it, and rather in connection with the epididymis.

The *Treatment* consists in injecting the sac with tincture of iodine, after incising the tumour and allowing it to granulate from the base. The injection by iodine, though successful in some cases, is not so successful as in this as in the last variety of the disease, but usually deserves a trial; if it fail, the incision of the tumour will always effect a cure.

HYDROCELE OF THE CORD.—This disease is characterised by the presence of a round or oval tumour, situated on the cord, below or within the inguinal canal. It is smooth, elastic, and, if of sufficient size, may be semi-transparent on examination by transmitted light. It can be pushed up into the abdomen, but receives no impulse on coughing, and does not alter in size on being steadily compressed. It appears to be formed, in some cases, by the funicular portion of the peritoneal investment of the cord being imperfectly closed and consolidated at points; though it is possible that in other instances it arises as a distinct cystic growth. These tumours may occur at all ages, but are chiefly met with in the young, and are not unfrequent amongst children.

Treatment.—The obliteration of the cyst is best conducted by passing a seton through it, or by making an incision into it, and letting it granulate from the bottom.

DIFFUSED HYDROCELE OF THE SPERMATIC CORD consists in the infiltration of the cord with serous fluid, contained in rather distinct cells, and giving rise to an oval or oblong irregular circumscribed tumour, extending below and into the inguinal canal.

The *Treatment* consists in the application of blisters, or of counter-irritant plasters. Should the disease prove very troublesome, an incision might be made down to and into the swelling, so as to let out the fluid and allow the cyst to become consolidated.

HEMATOCELE.—By *Hematocèle* is meant an accumulation of blood in the tunica vaginalis, distending that sac, and compressing the testis. It is of two kinds, *Traumatic* and *Spontaneous*. The *Traumatic* is the most common form of the disease, usually arising from a blow on or a squeeze of the testis, by which one of the veins ramifying on the surface of the gland is ruptured, and blood is poured into the tunica vaginalis. It may also arise in tapping a hydrocele, from the point of the trochar being pushed too directly backwards and puncturing the testis. *Spontaneous Hematocèle* is a disease of rare occurrence, arising apparently from the rupture of an enlarged spermatic vein into the tunica vaginalis. It attains a larger size, and is altogether a more formidable affection, than the traumatic hematocèle.

Characters.—In whatever way occurring, a hematocèle slowly but gradually increases in size, until it attains about the magnitude of a duck's egg, or even that of a cocoa-nut. It is seldom that it becomes larger than this; but cases are recorded in which the tumour has attained an enormous magnitude. I once operated in a case in which a spontaneous hematocèle had existed for six years; it was as large as a good-sized melon, and contained, besides about a quart of dark thin blood, a handful of partially decolorised and tough fibrine, the greater portion of which was firmly adherent to the inside of the greatly thickened tunica vaginalis in filamentary and laminated masses, with here and there nodules interspersed. The whole of the interior of the tunica vaginalis closely resembled an aneurismal sac.

The fluid contained in the hematocèle, when the disease is recent, consists of pure blood; but when of old standing, it is of a dark and grumous character, owing to disintegration of the blood-corpuscles. It then usually contains an admixture of cholesterine. The blood so effused will continue fluid for years; but at last it may decompose and set up fatal inflammatory mischief; in some rare instances the tumour becomes partly solidified by the deposit of masses of fibrinous coagulum, lining the interior of the tunica vaginalis, which are sometimes decolorised and arranged, as in the case just referred to, and in one recorded by Bowman, in a laminated manner, like the contents of an aneurismal sac.

Symptoms.—These are generally sufficiently obvious. The occurrence of the tumour subsequently to a blow, strain, or injury when tracing a gradual increase in size, its somewhat heavy but semi-elastic feel, its shape, and the absence of transparency, together with the freedom of the cord above and the want of impulse in it on coughing, will indicate its character.

Treatment.—This must vary with the size and duration of the tumour. When it is small and recent, and has fluid contents, the surgeon may attempt the effect of tapping it; it is possible that, after the evacuation of the



FIG. 501.—Hematocoele with Thickened Tunica Vaginalis and Adherent Fibrinous Deposit.

closure and obliteration of the tunica vaginalis will take place. This happened in a case under my care, in which, though the disease had existed for three years, a complete cure followed the operation of tapping. Such simple treatment as this, however, cannot be depended upon; and it is usually necessary to lay the sac open, and to allow it to contract and to granulate from within, when the obliteration of the cavity of the tunica vaginalis necessarily results. In the tumours were of very large size, and the tunica vaginalis much thickened, hard, and parchment-like, with adherent organized fibrine, castration might be required. In the instance to which I have already referred, and which is represented in Fig. 504, this was rendered necessary in consequence of the conditions, and was successfully done.

HEMATOCELE OF THE SPERMATIC CORD has been observed by Pott, Bowman, and others; it is a rare disease, and usually occurs in the form of a tumour of considerable magnitude, suddenly arising after a strain or violent exertion, giving rise to the rupture of a varicose spermatic vein. It commences in the inguinal canal, and thence extends downwards along the course of the cord, through the abdominal ring into the scrotum; but it does not surround or implicate the testis, which can be felt free and movable in its lowest part. On incising such a tumour as this, a quantity of fluid, partly fluid and partly coagulated, has been found, sometimes containing a cavity, occasioned by the laceration and separation of the tunica vaginalis of the cord and scrotum. The most remarkable case of this kind on record is related by Bowman, in which the tumour, after existing for ten years, had attained so enormous a size, that it reached to the patella, and was so large as to require both hands and a considerable effort to raise it from the scrotum. In this case, death appears to have resulted from decomposition of the contents of the tumour.

Diagnosis.—In its early stages, hematocele of the cord would not be considered a risk of being confounded with an inguinal hernia. The fluctuating character of the swelling, however, its irregular feel, and its fluctuating sensation, might enable the diagnosis to be made. Hematocele of the cord may always be distinguished from an accumulation of fluid in the tunica vaginalis, by the testicle not being implicated in the formation, but surrounded by the fluid in the latter instance.

The *Treatment* of this disease must in the earlier stages be of a palliative kind; consisting in rest, support of the tumour, and the application of soothing lotions. Care should be taken not to incise it at this period, lest the loss of blood from the ruptured vein, after the evacuation of the

of the tumour, become uncontrollable. In one instance I have known fatal consequences from this cause to ensue in half an hour after making an incision into the tumour and turning out the coagula. When, however, the disease has reached a chronic stage, and is no longer increasing, it may be incised; and, its contents being turned out, the cavity may be allowed to suppurate and granulate.

VARICOCELE.

Varix, or *Enlargement of the Spermatic Veins*, is a disease that is commonly met with from the age of puberty to about the thirtieth year, seldom commencing later than this. It usually occurs in feeble individuals having the scrotum lax and pendulous; and in some cases appears to have been brought on by venereal excesses. The spermatic veins, extending as they do from opposite the upper lumbar vertebra to the plexus pampiniformis, which constitutes the base of the pyramidal tumour formed by a fully developed varicocele, are necessarily subject to considerable outward pressure from the weight of so long a column of blood as that contained within them, to which they may eventually yield, becoming much dilated and tortuous. The left spermatic veins are far more frequently affected than the right; partly owing to their compression by feculent accumulations in the sigmoid flexure of the colon, and partly to the obstacle at the mouth, occasioned by their pouring their contents into the left renal vein, at right angles to the current of blood flowing through that vessel into the vena cava. The right spermatic veins are rarely affected; and never, I believe, without those on the left side participating in the disease. In these cases of double varicocele, the left is almost invariably the more seriously affected; but I have seen exceptions to this in one or two instances, in which the veins on the right side formed the larger tumour.

SYMPTOMS.—The symptoms of varicocele consist of a tumour of pyramidal shape, having a knotted or knobbed feel, owing to the irregularly swollen and convoluted condition of the veins, with its base upon the testis and the apex stretching up to the external ring. The swelling increases when the patient stands up, if he take a deep inspiration, cough, or make any violent exertion. Its size varies from slight fulness of the veins to a large mass, several inches in circumference at the base. When the patient lies down, it goes up to a certain extent, but immediately returns to its former magnitude when he stands up again. It is attended by a sensation of weight and sometimes of pain, which is occasionally very acute, of a severe and neuralgic character, even in the scrotum, the groins, and the loins, more particularly when the tumour is unsupported. This pain is greatly increased on the patient walking or riding; so much so, that in some cases he is almost debarred from taking necessary exercise, and is prevented from following any active occupation. Debility of the generative organs, with a tendency to seminal emissions and much mental depression, frequently accompanies varicocele. The rupture of a varicocele may occur from external injury, giving rise to an enormous extravasation of blood into the cellular tissue of the scrotum: on one occasion I have known this to be attended by fatal consequences. The tumour having been incised, and large masses of coagula having been turned out, the patient died of venous hemorrhage.

DIAGNOSIS.—The diagnosis of varicocele is always sufficiently easy; its peculiar feel, its broad base and narrow apex, the manner in which it goes up when the patient lies down, and returns again when he stands up, are sufficient to distinguish it from all other scrotal tumours. From *inguinal hernia* disease may be distinguished by attention to the test described at page 10

subject to varicocele, especially those who habitually lead a sedentary and studious life, as, for instance, young clergymen and lawyers. In these persons, a peculiarly hypochondriacal state is brought on by the tendency of the mind to dwell on the condition of the genital organs, and the patient is constantly fidgeting about the local and tangible disease he observes in them.

How should the radical cure of this condition be produced? To this I would answer—By exciting adhesive inflammation of the spermatic veins, through an application of the same principle which sets up that process in the veins of the lower extremity. There are several different ways of doing this; some are very objectionable. The twisted suture, as applied to the veins of the leg, induces too great irritation in the scrotum, and there its introduction is often followed by violent inflammation or sloughing, or by an opening up of the cellular tissue of the scrotum with oedema, and even purulent infiltration. It is better, I think, not to use this method here; in deed I have twice, in the practice of others, seen it followed by death. The plan I have adopted for some years is that suggested and practised by Vidal de Cassis, and is as follows. The vas deferens, readily distinguished by its round cord-like feel, is first separated from the veins, and entrusted to an assistant; next, an iron pin, bored with a hole at each end (Fig. 505),



Fig. 505.—Iron Pin for Treatment of Varicocele.

is passed between the vas and the veins, and brought out, the scrotum being first notched with a scalpel at the point of perforation; then a silver wire, threaded on a needle so constructed that the wire shall follow it without catching (Fig. 506), is passed in at the aperture of entry of the



Fig. 506.—Needle threaded with Silver Wire.

needle, and carried between the integument of the scrotum and the veins, the wire being brought out at the second puncture (Fig. 507). Each end of the wire is now passed through the corresponding hole of the pin, which is twisted round and round repeatedly, each turn causing the wire to be rolled around the pin, and so tightened till the veins are firmly compressed between the pin behind and the loop of wire in front (Fig. 508). By this means the scrotum is quite free and uncompressed, and there is no danger of arousing inflammation or oedema. The wire should be tightened from day to day, as it causes ulceration in the veins until it has completely cut through, which results, usually, in about a week or ten days. Meanwhile, there is much plastic matter thrown out around the veins; this finally contracts and obliterates their channels. This method produces an effectual and permanent cure.

Of late, I have been in the habit of employing a simpler method. I separate the vas in the usual way, and then make a small incision, about half an inch long, in the front and back of the scrotum: afterwards I pass a needle armed with silver-wire, as before described, between the vas and the veins, bringing it out behind; I then return the needle, but this time carrying it in front, between the veins and the skin; and thus the veins are included in a loop of wire, without implicating the scrotum. The loop is then tightly twisted together, so as to constrict the enclosed vessels. This plan has a similar effect to that of the wire and pin combined; by repeated

tightenings the wire gradually effects the veins, which are obliterated by the an-

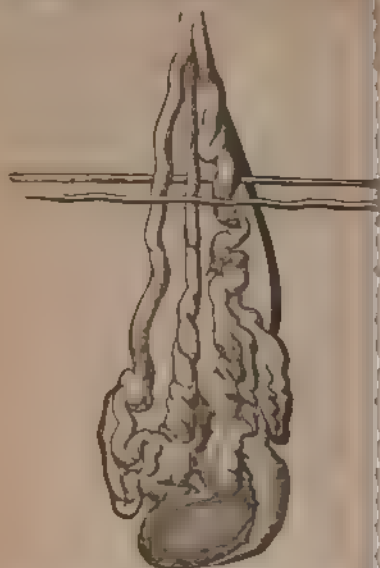


Fig 507.—Treatment of Varicocele: Introduction

It has been objected to this and the testis may take place, from its artery the veins; but, as the spermatic artery is held out of the way with that device mischief is avoided. Nevertheless, the result of long-continued pressure of the wire before the performance of the operation

TUMOURS OF

All solid tumours of the testicle are termed *Sarcocele*; and, when these are within the tunica vaginalis, they are termed *intravaginal*; and are divided into the *Simple*, the *Syphilitic*, and the *Malignant*; which, indeed, comprise a class requiring separate study.

SIMPLE SARCOCELE is a chronic or inflammatory mischief in the organ. It is hard, smooth, solid, though perhaps of an irregular shape, and usually about as large as a walnut, and slightly painful. The cord is usually enlarged, is the seat of pain of a dull or aching kind, and not unfrequently contains serous fluid. The tumour of the testis constituting the disease can usually be distinctly distinguished from the injury, by which inflammation had been produced, is always healthy.

Structure.—On making a section of the testis, it is found to be composed of a quantity

plastic matter, effused within the organ and between the tubuli, and also surrounding the gland, often in a series of solid and very firm glistening layers. In the midst of this, opaque yellow spots or masses, cutting smooth and firm, will be seen. These have been mistaken for tubercles, but are in reality masses of plastic deposit that have undergone fatty degeneration.

Treatment.—Strapping and the administration of an alternative course of bichloride of mercury may be tried. If the testis do not diminish in size by these means, or if it be a source of much inconvenience to the patient, it must be removed.

TUBERCULOUS SARCOCELE, or SCROFULOUS TESTICLE.—This disease, although occasionally met with in individuals otherwise strong and healthy, chiefly occurs in those of a feeble or cachectic constitution, usually in early manhood, and, although commonly associated with a tendency to phthisis, often occurs without any evidence of tuberculation in other organs or tissues than the testes. It commonly results from a blow, squeeze, or other injury, as a sequence of gonorrhoeal epididymitis, or from any cause that may produce chronic orchitis; the inflammation owing to constitutional predisposition becoming strumous and leading to the deposit of tubercle. Sometimes it occurs as the result of ulterior changes in the syphilitic sarcocele. It is essentially characterised by the deposition of tuberculous matter in the testis. The tubercles may occur as grey granulations; they may be infiltrated or encysted, varying in size from a pin's head to a cherry- or plum-stone. When encysted, they are of a bright yellow colour, tolerably firm and lustrous, contrasting strongly with the inflamed gland, in the midst of which they are deposited. Tubercles in all stages of development and disintegration are commonly found in the same organ. They are usually first deposited, and accordingly are more advanced, in the epididymis, more especially about its head. The irritation occasioned by their presence usually gives rise to abundant lowly organised plastic deposit in the organ. Their presence in and between the tubuli eventually produces inflammation, suppuration, and ultimate disorganisation of the structure of the testis, with which they become mixed up, so as to form a pulsatious cream or cheesy mass of a dirty buff colour.

Symptoms.—The strumous or tuberculous sarcocele presents three varieties, the symptoms of which vary somewhat. The first is characterised by a fungous protrusion; the second by a soft pulpy feel; and the third by its association with syphilitic disease.

1. In the most common variety, without any very evident cause, or perhaps after injury, gonorrhoeal inflammation, or venereal excesses, the testes gradually and slowly enlarge, often attaining a very considerable bulk, and usually becoming at the same time nodulated and irregular, hard and craggy; the hardness is confined to the nodules, the gland feeling soft between them; and hydrocele occasionally coexists. The epididymis is most commonly the part that is first affected in this way, though not unusually it is the body of the organ that suffers. Though the disease commences in one testis, both almost invariably at last suffer, either simultaneously or successively. One of the nodulated masses in the affected testis usually gradually increases in size, the skin covering it becomes red, shining, and thinned; and at last adhesion forms between it and the testis, indolent suppuration takes place, and on the discharge of the abscess a fistulous opening is left. Through this aperture a fungus speedily protrudes, which grows sometimes slowly, sometimes rapidly, perhaps attaining a very considerable size (Fig. 509). As the fungus increases, the organ appears to atrophy, but in reality is drawn out of the scrotum and merges into the fungus. This

fungus is not a new growth, but is the tubercle testis and lymph. It



Fig. 204.—Fungous Tubercle in Testis.

granular outgrowth with lymph continuing chronic inflammation, and secreting in the mass. It is, however, this organ a great traversed

2. In testis de enlarging

but uniform and smooth; in fact, an outgrowth of a fungus. In this variety active; and the lowly organised lymph, mixed with debris of the tunica vaginalis, into which it has envelopes of the testis are incorporated.

3. In the third variety of scrofula conjunction with syphilitic sarcocoe being deposited in the midst of a sarcocele.

Treatment.—The treatment of the protruded, must be conducted on the general of scrofula: alternatives, tonics, castor oil, and general hygienic means carefully persevered in for some length of time will consist in the application of discutient iodine lotions, or the iodine.

When the fungus has protruded, means must be taken to repress or destruction of the testis. If it be sprinkled with red oxide of mercury, a piece of lint and strapping. If the surface then dressed with the ointment taken, during cicatrization, to repress the surrounding integument by strapping. It is recommended that the pressure should be an elliptic incision being made round the swelling structure of the testis, it is brought down and then brought over the top. This operation I have practised with large size, so as to include within the organ. On shaving off such a protuberance may be found deeply infiltrated with it is better to remove the whole of any service, and would continue also

SYPHILITIC SARCOCELE, both in its simple and its strumous character, has already been considered at page 545; to which I would refer the reader.

CYSTIC DISEASE OF THE TESTIS, or **CYSTIC SARCOCELE**, may be of two kinds: *simple* or *malignant*. When *simple*, it is a disease somewhat analogous to the cystic sarcoma of the breast. The testis becomes much enlarged, indurated, of a yellowish-white and opaque appearance, and studded with a multitude of cysts that vary in size from a pin's head to a cherry, containing clear amber coloured or brownish fluid (Fig. 510). This affection, consisting in the alteration and condensation of the orchitic structure, with the formation of these distinct independent cysts, must not be confounded with the accidental occurrence of a cyst or two in a serofulous testis. It is a local affection; and, although the organ may attain a considerable bulk, it never gives any indication of malignancy.

Diagnosis.—This affection has been carefully studied by Sir A. Cooper; who, with great justice, adverts to the difficulty of distinguishing it from other diseases of this organ, more especially from *hydrocele*. The points to be especially attended to in distinguishing the cystic sarcocele, are its want of translucency, the more globular shape of the organ, its weight, and the enlarged and varicose state of the veins of the cord. If there be any doubt, an exploratory puncture will resolve this, and should always be practised.

Structure.—According to Curling, cystic disease of the testicle is the result of morbid changes in the ducts of the rete testis. When of an innocent character, the cystic disease is characterised by the presence of tessellated epithelium in the cysts; when malignant, by the presence of nucleated cancer-cells. In addition to this, enchondroma may be met with in both forms of cystic disease; and almost invariably in old cases of the innocent variety.

Treatment—Cystic sarcocele requires removal of the diseased organ.

Cysts containing Coloured Matters.—Occasionally, cystic tumours of the testicle are met with, in which the substance of the organ is atrophied or absorbed, and its place occupied by one or more large thin-walled sacculi containing fluids of different colour and consistence, dark or fatty. One of the most remarkable of these anomalous tumours of the testis that I have seen was under the care of my colleague, Mr. Marshall, at the Hospital. The diseased organ, which was of about the size of an ostrich's egg, and felt partly solid and partly fluid, was found after removal to be composed of a large cyst filled with an oily fluid, like melted butter, which solidified on cooling. After removal, Mr. Marshall found that the sac contained some foetal debris, and was doubtless of an embryonic character. The patient, who was about thirty years of age, had been affected with the tumour from early infancy.

MALIGNANT SARCOCELE, or CANCER OF THE TESTICLE, not unfrequently occurs, and almost invariably assumes the encephaloid character. It is, indeed, a question whether any other form of cancer ever occurs in the testicle. Dr. Walshe agrees with most observers in doubting the existence of the other varieties of malignant disease in this organ.



Fig 510.—Simple Cystic Sarcocele.

spermatic artery and accompanying veins.

The lymphatic glands in the neighbourhood in the iliac fossa especially, as may be ascertained by the flank. The inguinal glands do not in general become implicated by the progress of the disease, but the cancerous cachexy rapidly develops itself.

The *Symptoms* of encephaloid testicle are in the early stages, although they become clearly marked as the disease progresses. The patient first begins to feel a dragging pain and weight in one of the testicles, which is found to be indurated and enlarged, though the enlargement continues until the testicle is as large as a duck's egg, being somewhat tense and firm. As it increases in size, which it usually does, it becomes rounded and somewhat doughy or pulpy in feel, and may almost be semi-fluctuating, though it is not knobby. This alteration in feel is partly due to the nature of the tumour, and partly to its making the scrotum distended, red, and covered by a network of tortuous veins; the scrotum is enlarged, hard, and knobby. As the disease advances, the testicle becomes adherent at some of the softened parts, and projects, which presents all the characters of a cancerous growth. It does not commonly happen, however, that the testicle is so far as this before removal. The pain is not severe, but at a time assumes a lancinating character, extending to the groin.

Treatment.—The only treatment of any value is the removal of the diseased organ. This operation is performed with the view of curing the patient of his disease, and of relieving him from the suffering and inconvenience of the disease.

tised. The operation may be performed in the following way. The patient, having had the pubes shaved, should lie upon his back with the legs and thighs hanging over the end of the table. The surgeon should then take his stand in front of the patient between his legs, and, grasping the tumour at its posterior part with his left hand, make the scrotum in front of it tense. If the mass to be removed be of small size, he makes a longitudinal incision over its anterior surface; if of large size, a double elliptical incision, enclosing a portion of the scrotum. The incision should commence opposite to the external abdominal ring, and be carried rapidly down to the lower part of the scrotum. By a few touches with a broad-bladed scalpel or bistoury, whilst the skin is kept upon the stretch, the tumour is now separated from its scrotal attachments, and merely left connected by the cord, which must then be divided. In some cases, it will be found advantageous to expose and divide the cord in the first instance, before dissecting out the tumour from the scrotum, as in this way a better command over it is obtained.

The *Division of the Cord* constitutes the most important part of the operation, whether this be done first or last; as, unless care be taken, it may be retracted through the abdominal ring into the inguinal canal, where it is extremely difficult to follow it, and where the cut stump may pour out a large and even fatal quantity of blood into the cellular tissue, and between the muscles of the part and into the flank. This accident is prevented by giving an assistant charge of the cord before its division, and directing him to hold it tightly between his finger and thumb (Fig. 511); or, what is better, by passing a sharp hook through it, and thus fixing it. After the removal of the testicle, two or three arteries in the cord will generally require ligature, as well as a few bleeding branches in the scrotum. Sutures are not required, the edges coming into apposition of themselves; the wound must then be lightly dressed, and allowed to heal by granulation; bagging in the lower part being prevented during the after-treatment.



Fig. 511.—Division of the Cord in Castration.

In cancer of the testicle, it is of great consequence to divide the cord as high up as possible, for obvious reasons. It will not, however, be safe to do this opposite the abdominal ring in the way that has just been described, as there would not be sufficient space for the assistant to hold the cord above the part to be divided. In cases of this kind, I have found it a good practice to expose the cord by dissection up to the abdominal ring; then to draw it well down, and to include the whole in a strong whipcord ligature, tied round it as tightly as possible. The section is then made a quarter of an inch below this, and the operation is completed as usual; the cut stump of the cord may retract into the inguinal canal, but cannot bleed if properly tied, and will always be under command by drawing upon the whipcord.

This plan of tying the cord *en masse* was at one time general in all cases of castration, but is not now commonly employed. To it is, that by compressing the spermatic nerves with the after-pan is increased, but this certainly does not always, three instances in which I have done it at the Hospital, but complained of; and the practice in malignant disease of the advantage of enabling the surgeon to divide the cord at a higher point than he otherwise could; which advantage is still further increased by the with in and below the ligature sloughing away, and thus even the section to a level with the point tied.

GENERAL DIAGNOSIS OF SCROTAL TUMOURS

The diagnosis of scrotal tumours is not only of considerable importance, but is often attended with very great difficulty: the more frequently associated with one another, so that much time



Fig. 512.—Encephaloid Testicle with Hydrorachis of the Tunica Vaginalis and of the Cord.

required to discriminate them. Thus it is not uncommon to find a hernia and a hydrocele; or these affections coexisting with a tumour of the testicle. In other cases, as in the annexed figure (512), a tumour may coexist with a hydrocele of the cord.

Tumours of the scrotum, from a diagnostic point of view, be divided into two distinct classes.—1, the Reducible; 2, the Irreducible.

1. REDUCIBLE TUMOURS.—These include the Congenital Hydrocele, Diffuse Swelling of the Cord, and Varicocele; in all of which the swelling can be made to disappear more or less completely by pressure.

The patient lying down; reappearing on the removal of the pressure, assuming the erect posture. The mode in which the tumour tends greatly to establish its diagnosis; though the general appearance, swelling, and the history of the case, afford important collateral evidence at this point.

a. In *Hernia* there are the ordinary signs of this affection, as on coughing, &c. On reducing the tumour, it will be found that its return into the abdomen is accompanied by a gurgling noise, and that it slips upwards of evidently a solid body. In the other reductions, the diminution and eventual disappearance under pressure are gradual, and there is no reduction of the mass as a whole.

b. The gradual squeezing out of the contents of a *Congenital Hydrocele* together with its translucency, and the early age at which it is first established, establish its true character.

c. In the *Diffuse Hydrocele of the Cord*, there is an uniform swelling in and near the ring; in which, however, there is no complete and sudden disappearance as in hernia. It is also soft, and has a less distinct impulse on coughing.

d. *Varicocele* may always be distinguished by its pyramidal shape, its knotted, soft, and irregular feel. After being reduced when the patient lies down, it will, when he stands up, fill again, even though

compress the external ring with his fingers. This sign, which distinguishes it from a hernia, occurs also in hydrocele; from which, however, the varicocele may be distinguished by the absence of translucency, the want of fluctuation, and the general feel of the tumour.

2. IRREDUCIBLE SCROTAL TUMOURS are of various kinds; such as Omental Hernia, Hydrocele, Hematocele, the various forms of Sarcocoele, and Cancer of the Testicle. These tumours, though presenting certain characters in common, yet differ somewhat in the predominance of particular signs. Thus, the shape of the tumour is usually pyriform in hydrocele, globular in hematocele, and oval in sarcocoele; though this is subject to much variation. The weight is least in hydrocele and greatest in sarcocoele, proportionately to the size of the tumour. The characters of the surface present considerable differences, being smooth and tense in hydrocele and hematocele; often irregular, hard, or knotted in the other varieties. The rapidity of the formation of the tumour is greatest in hematocele.

a. *Irreducible Scrotal Hernia* may be recognised by its irregular feel, by its impulse on coughing, by its occupation of the canal, and by the testicle being distinctly perceptible below it.

b. *Hydrocele of the Tunica Vaginalis* is always recognisable by its translucency; and the amount of opacity conjoined with this will enable the surgeon to distinguish the degree of enlargement of the testis, and how far there is a sarcocoele conjoined with it.

c. In *Hematocele* the tumour is of sudden or rapid formation, somewhat globular, opaque, but not very heavy or hard, and smooth upon the surface.

d. In *Sarcocoele* generally the tumour is heavy for its size, frequently globular or irregular in shape, sometimes knobbed, and usually attended by a good deal of dragging pain in the groin, and frequently by some enlargement of the cord.

The point of most importance in the diagnosis of sarcocoele is to distinguish the malignant from the non-malignant varieties. In the malignant, the rapidity of the growth, the softness and the elasticity of the tumour, the implication of one testis only, and the early enlargement of the cord, with its indurated and knobbed condition, are important signs; especially if the disease occur in young men. In a more advanced condition, the softening of the swelling at parts with a tuberos condition of the rest, and the occurrence of fungus with speedy constitutional cachexy, will point to the malignant nature of the tumour. In cases of much doubt and difficulty an exploratory puncture may be made, when the contents of the groove in the needle or of the fine cannula will probably determine the character of the growth. In more than one instance, in which there was much obscurity, I have seen the true nature of the disease cleared up in this way.

IMPOTENCE AND SPERMATORRHOEA.

Various forms of debility, of loss of power, or of irregularity of action in the generative organs, are confounded together under the terms *Impotence* and *Spermatorrhœa*. These conditions require a more careful consideration on the part of the educated surgeon than they have hitherto received, as their existence is a source of the greatest mental depression and distress to the sufferer: it is certainly one cause of conjugal infidelity, and occasionally believe, of suicide. These affections, which are of extreme frequency in all classes of the community, but more especially amongst the over-educated, having scarcely as yet received that attention on the part of the profession generally that their importance deserves, the unfortunate sufferers from are too often driven into the hands of those pestilent quacks that do

the metropolis, and infest almost every town in the country, they are not unfrequently ruined in health as well as in part.

We may, I think, recognise at least three distinct varieties of debility and impotence: 1. True Spermatorrhœa, or Seminal modic Spermatorrhœa, or Spermaspasmus; and, 3, that arises from a seminal secretion, or Asperma.

1. TRUE SPERMATORRHŒA, or SEMINAL FLUX, is chiefly met with in men usually from the ages of eighteen to thirty. It is the consequence of masturbation in boyhood, of debility of the system induced by gonorrhœa, or of the continued struggle to resist sexual desires by a life of forced or unavoidable continence. In the disease there is a mixture of irritability and of debility. The genital organs are excited by slight emotional causes, or by trivial physical stimuli—a thought, a look, a word, the movement of the body, the effort of straining at stool, will excite the secretion of semen. In the debilitated state of the parts allows to escape with a feeble effort. In the slighter cases, and in the earlier stages of the disease, the emissions take place but occasionally—three or four times a week, in the morning, in the mid state between waking and sleeping, or by an erection. In the more advanced stages, the emission is more frequent, often in the twenty-four hours without an erection; when discharged, flowing back into the neck of the bladder with each discharge of the urine, or after defecation. The physical and mental state becomes seriously implicated in these cases of spermatorrhœa. His countenance is pallid, anæmic, and sallow; his spirits are drawn; his eyes lifeless; his spirits depressed, often to the verge of despondency and despair. Connection is impracticable, as the emission of semen takes place before erection occurs.

Diagnosis.—This form of spermatorrhœa is apt to be confounded with prostaticorrhœa (p. 1151); but the diagnosis may always be made by microscopic examination of the discharge.

Treatment.—The curative treatment should consist in giving rest, and in lessening the irritability of the genito-urinary organs. This may be obtained by the administration of some preparation of opium, or especially by the habitual daily use of the cold hip-bath. The patient should use every night and morning; remaining in it, at first for three minutes, but gradually increasing the time of immersion to fifteen. In some cases the cold shower-bath appears to give more relief, and then should be preferred. These means, useful as they may be, however, cure the patient. For this purpose, the local irritation should be removed by the application of the nitrate of silver to the bulbous portions of the urethra. It will usually be found that there is a good deal of tenderness in these situations, felt on pressure of the perineum, or on passing an instrument into the urethra, when it enters the bulb, the patient will usually suffer much pain. This irritation certainly keeps up the nocturnal emissions, and the debility of the genital organs, and the nervous irritability characteristic of these cases. It may most effectually be removed by the application of the nitrate of silver, as originally recommended, and, if this be done in a proper manner, a cure will usually be effected. Of late years I have employed, with much advantage in such cases, an instrument here figured (Fig. 513). It consists of a silver rod, about a dozen minute apertures near the end. In the interior of the rod is a slender piece of sponge, about two inches long, fixed to the

of a firm stylet that moves within the catheter. The instrument is charged by filling the sponge with some solution of the nitrate of silver by with-

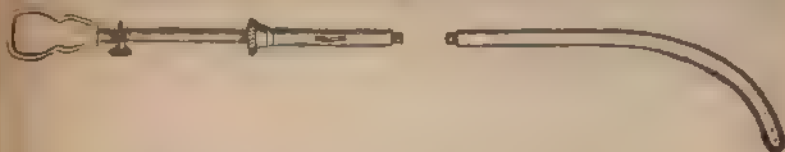


Fig. 513.—Syringe-catheter for applying Caustic to the Urethra.

drawing the stylet. It may then be well oiled; and, being passed down to the spot to be cauterised, the solution is forced out of the aperture by pushing down the rod, which compresses the sponge. I have found this syringe-catheter far safer and more manageable than Lallemand's or any other *parte-cavities* that act by protruding a spoon or sponge, which is apt to be grasped by the spasmodic action of the muscles of the part, often being returned with difficulty into the shaft, and not without risk of lacerating the mucous membrane. I generally use a solution of the strength of $\frac{3j}{\text{ounce}}$ of the nitrate to an ounce of water; though sometimes only a half or a third of this strength can be borne. The application usually occasions a good deal of irritation for a time, sometimes even a muco-purulent discharge, and can only be repeated at intervals of from ten days to a fortnight. Any undue amount of irritation must be subdued by ordinary antiphlogistic treatment.

2. SPASMODIC SPERMATORRHEA, or SPERMASPASMOS, more frequently occurs in men from the ages of twenty-five to forty. It is frequently predisposed to by residence in a warm climate, or by the existence of some disease about the generative organs; such as stricture, varicocele, neuralgia testis, &c. In these cases there is not, properly speaking, a seminal flux; but connection cannot be effected, as erection and ejaculation are either simultaneous acts, or the erection subsides before the emission takes place.

Treatment.—In these cases the treatment that is most beneficial consists in removing or curing, in the first instance, any local irritation that may exist, such as stricture or varicocele, and then endeavouring to give tone to the nervous and muscular structures of the part. For this purpose, I know of no remedy equal to strychnine. This may be given alone, or in combination with iron, 30 minims of the tincture of the sesquichloride with 10 of tincture of nux vomica, or 1-24th of a grain of strychnine with gr. v of citrate of iron twice a day; or gr. j of the extract of nux vomica in a pill with reduced iron, will be found of the greatest possible service in such cases. The irritability of the nervous system, which is associated with debility in these cases, is best remedied by the administration every night of a belladonna and camphor pill. In addition to this, local cold bathing, regular exercise, and absence of all exhausting mental labour, will be found of much service.

3. IMPOTENCE arising from absence of all sexual desire or power, or from premature decay of that power, is not unfrequently met with, and often in individuals who are otherwise strong and healthy; sometimes, indeed, in those characterized by great muscular power, and much given to athletic exercises. This want of sexual desire may be looked upon in many instances as a natural deficiency in the organisation of the individual, for which medical or surgical treatment can do little. In other cases, it arises from exhaustion of the nervous system by habitual physical exertion, carried to a too great and injurious degree. Complete absence of seminal secretion—*Asperma*—except in cases of atrophy or absence of the testes, must be

especially rare. In a patient of mine who died at 54 years of age according to his own and his wife's account, had been completely sterile for the twenty-four preceding years, spermatozoa in considerable numbers were after death found in the testes, which were carefully examined with a view of ascertaining whether they ever secreted semen.

CHAPTER LXXII.

DISEASES OF THE FEMALE GENITAL ORGANS.

SOME of the more important surgical affections of these organs, viz. vagino-vesical and recto-vaginal fistulae, lacerated perineum, and other forms of syphilitic disease to which they are liable, have already been discussed. The remaining affections, implicating the Vagina, the Ovaries, are of considerable practical interest; but, as the details of their treatment would lead me far beyond the limits that can be assigned in this work, I must content myself with a brief indication of the points deserving attention.

INTRODUCTION OF INSTRUMENTS.

SPECULUM VAGINÆ.—Vaginal specula of various shapes and

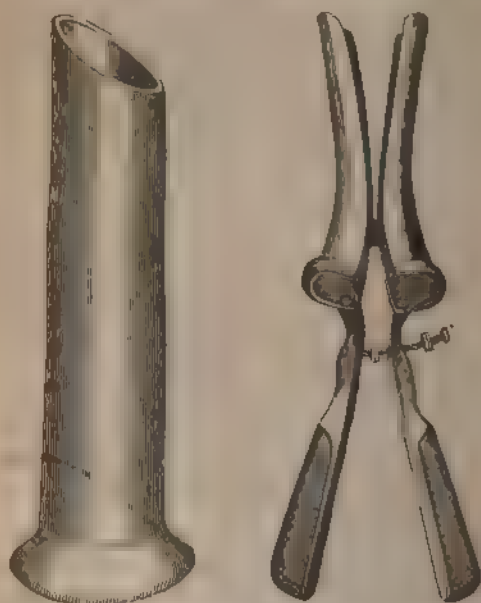


Fig. 514.—Cylindrical Speculum. Fig. 515.—Bivalve Speculum. Fig. 516.—Duck-bill Speculum. commonly used by surgeons. When the os and cervix of the uterus are to be explored, the most convenient instrument is certainly the reflecting glass speculum (Fig. 514); which, being coated with tinfoil, covered by India rubber, always presents internal reflecting surfaces, by which a strong body of light is thrown into the

the tube. It has the additional advantage of being very cleanly, and not stained by any caustics that may be used in it. These specula should be of different sizes, and may be sometimes advantageously bevelled off at the inner end. When the wall of the vagina requires examination, as in some operations on fistula, a bivalve speculum (Fig. 515), a cylindrical one, provided with a sliding side, or the "duck-billed" speculum (Fig. 516) may advantageously be used. These are generally made of plated metal.

Introduction of the Speculum may readily be effected, without any exposure of the person, under the dress or bed-clothes. There are two positions in which the patient may conveniently be placed for this purpose. In the first, she lies upon her back, with the nates well raised or brought to the edge of the bed or couch, her legs separated, and her feet resting on two chairs; the surgeon, standing or sitting in front of the patient, introduces the fore and middle fingers of his left hand into the vagina, dilates its walls, and passes the speculum, well greased, gently and steadily between and under them. This position is the most convenient when caustics require to be applied, but is often objectionable to the patient, as it appears to entail much exposure, though in reality it need not do so. Another mode of introducing the speculum, which should always be adopted when practicable, consists in placing the patient on her left side across the bed, with the knees drawn up, and the nates near the edge; the instrument is then introduced in the same way as before, the surgeon sitting by the patient's side. In whichever way the speculum is used, no force should ever be employed; the patient should be placed opposite a good light, and care should be taken that the instrument be introduced fairly to the uterus, the position of which may have been previously ascertained by tactile examination.

FEMALE CATHETER.—The use of the female catheter is often required in various diseases and operative procedures about the genito-urinary organs of women. It should be introduced without exposure, by the aid of the touch alone. This may readily be done, as the patient lies in bed, under the clothes. The surgeon, standing on her left side, passes his left index finger downwards between the nymphæ until he feels the projection of the meatus urinarius, immediately above the entrance into the vagina; keeping his finger just below this, he uses it as a guide to direct the point of the catheter into the canal.

DISEASES OF THE EXTERNAL ORGANS AND VAGINA.

The vulva and the nymphæ are the seats of numerous morbid conditions, principally consisting of hypertrophy or of verrucous growths from them, or the formation of cysts in their substance.

HYPERTROPHY OF THE LABIA to a limited extent is not unfrequently met with, one labium hanging down considerably below the other. In these cases, it will often be found that the enlargement is due to a kind of solid œdema, originally dependent perhaps upon a fissure or ulcer of the part. In other cases, large fibro-cellular tumours form as outgrowths from the natural structures in this region; these may require removal by simple excision.

LARGE CONDYLOMATA or **VERRUCÆ** are often met with here, as the result of gonorrhœal or syphilitic disease, forming at last irregular pendulous masses, which require extirpation, either by knife or scissors. I have had occasion also to remove a large *Narus* by ligature from this situation; and, in fact, almost any growth that occurs in the fibro-cellular tissue may be met with here.

CYSTIC TUMOURS are not unfrequently met with in the sometimes resemble rather closely the ordinary form of it with which, however, their incompressibility, irremovability, of impulse on coughing, will prevent their being confounded, which require removal by a little simple dissection, usually turbid, or sanguinous fluid, and sometimes atheromatous and free hemorrhage may follow their removal, the excitable tissue being cut into. This may, however, always be arrested by T-baudage. Occasionally they project from the inside of the then require removal by dissection or ligature, as can be seen.

IMPERFORATE VAGINA is occasionally met with in young occasions a good deal of anxiety to the parents. This could may always be very readily and speedily removed by tearing, as it were, by dragging open its walls in opposite directions through the adhesions, which are little more than epithelial, nail, a blunt probe, or the handle of a scalpel, and then with pledget of greased lint.

IMPERFORATE HYMEN is occasionally met with, causing pain, and even danger, by the retention of the menses, which may accumulate to an immense extent, and become covered of chocolate-coloured grumous fluid. This malformation does not attract attention until the age of seventeen or eighteen. When the flux has, however, not appeared, notwithstanding periodical disturbance, an examination is instituted, and the cause of it is revealed. In these cases the hymen, which forms a dense membrane, is pushed down between the vulva, and the accumulation may sometimes be felt as an elastic fluctuating tumour above in the iliac fossa.

The *Treatment* consists in puncturing the hymen with a tenaculum, the opening with a probe pointed bistoury, and thus discharging the fluid, which may be in very large quantity. This operation is usually attended by danger. Suppuration of the exposed cavity may come on, ending in the patient's death. In opening it, it need scarcely be said that wounds of the urethra should be avoided; and, with care, that canal may always be avoided. I ever, seen one case in which it had been slit up by the surgeon, and the membrane.

Occasionally the surgeon's advice may be sought by married women, who are *right and only partially perforate hymen*; when incision with the bistoury, and dilatation with a sponge tent may be required; however, is possible, even though the hymen be not ruptured. It may be necessary during parturition actually to complete the opening of the membrane, if thickened and unruptured, though in most cases it may pass away under the pressure of the foetal head.

ABSENCE OF THE UTERUS AND OVARIES, with imperforate hymen, is occasionally met with in women, otherwise perfectly well, the external organs of generation, labia, and nymphæ being perfectly developed. In such cases, it is remarkable that sexual intercourse exists. The true condition may, however, be detected by examining the rectum, and especially by the introduction of a catheter into the rectum, whilst the finger is in the vagina, when the two cavities will be found in close apposition without the intervention of uterus or ovaries. In cases of this kind in which I have been consulted, there had

epistaxis. No surgical interference can be of any avail in such cases ; and an attempt to restore the vagina would necessarily lead to fatal results by opening the peritoneal cavity. Occasionally, if the woman have been married, the fruitless attempt at coition on the part of the husband has caused dilatation and expansion of the urethral orifice to such an extent that the index finger may be introduced into the cavity of the bladder ; and I have known this expanded urethra mistaken for the vaginal aperture, coitus effected into it, and the existence of the malformation for a time completely overlooked. *Simultaneous* vesical and rectal exploration will always clear up the true nature of the case.

HYPERTROPHY OF THE CLITORIS is occasionally met with ; this organ becoming enlarged, elongated, and pendulous, and in some cases attaining an enormous size. When the clitoris is enlarged, it may give rise to a good deal of irritation, and require excision, an operation that would probably be followed by rather troublesome hemorrhage.

Removal of the Clitoris, even though not much enlarged, has of late years been recommended as a means of cure in some forms of erotomania. I performed the operation for this purpose on a patient of Dr. Horsburgh's, and found some difficulty in stopping the bleeding, which at last required the application of the actual cautery before it could be arrested. The operation was, I believe, followed by marked improvement in the young lady's mental condition.

TUMOURS of various kinds are met with in the interior of the vagina, springing from its walls. These may be of a *Cystic* character ; but occasionally true *Mucous Polypi* are found dependent and projecting from the side of this canal. These may most readily be removed by trussing their base by a double whipcord ligature, and then strangling it. In performing this operation, however, when the tumour grows from the posterior wall, care must be taken to ascertain by proper digital examination, that a portion of the rectum has not been dragged down into its base.

PROLAPUS of the anterior or the posterior wall of the vagina may occur, giving rise, in the first instance, to protrusion of the bladder or *Cystocele* ; in the other, to a *Rectocele*. In either case, but especially in the first, it occasions very serious and troublesome consequences, amongst which chronic irritation of the mucous membrane of the bladder, with perhaps phosphatic deposits in the urine, are the most marked. These protrusions may be supported by the use of properly constructed belts or pessaries.

In some cases the surgeon may feel disposed to undertake plastic operations, in order to narrow the vaginal orifice by freely paring the opposite portions of its walls, bringing together the freshened surfaces by means of the quilled suture, and thus procuring narrowing of the canal and permanent support to the protruded part. The success of such operative proceedings will greatly depend on attention to details. The mucous membrane at the orifice of the vagina should be dissected off from about half an inch below the meatus on one side, to a corresponding part on the other, in a strip about an inch and a half wide ; the dissection being carried well up posteriorly in the fourchette. Two or three deep, and as many superficial, sutures should be passed ; the deep being left in for about five, the superficial for seven, days. Great attention should be paid to cleanliness, the patient lying on her side with a catheter in the bladder communicating with an India-rubber tube to carry off the urine ; and the bowels should be confined by opium.

VARIOUS DISCHARGES connected with the female organs of generation fall under the observation of the surgeon ; these may occur from the external

organs, from the mucous membrane covering the cervix uteri, or the interior of the cavity of that organ. These discharges, when proceeding from the mucous membrane covering the external organ, or lining the vagina, are frequently, though not necessarily, of a gonorrhoeal character; and require to be treated in the way that has been mentioned at page 1227. When they are of a simple nature, proceeding from mere hyperæmia of these parts, astringent injections, and attention to the general health, usually succeed in effecting a cure.

When these discharges proceed from the cervix or the interior of the uteri, they will commonly be found to be dependent upon a chronic inflammation or congested condition of the organ, or upon a papillated, fissured, or ulcerated condition of the mucous membrane, often accompanied with more or less local thickening and induration of subjacent structures. These various conditions, often of a very persistent, insidious, and dangerous character, have of late years been fully recognised by the labours of the French surgeons, more particularly of Lisfranc, Einery, and Jobert. In this country their pathology has been greatly elucidated by Dr. Bennet. To Dr. Bennet especially is due the great credit of having pointed out the true pathology of various uterine diseases that were previously imperfectly recognised, and of having shown that many of the functional diseases of the uterus are in reality dependent on chronic inflammation, and other structural lesions of this organ.

Symptoms. These uterine discharges, occurring usually as the result of chronic inflammation and its consequences, just as we find on other surfaces, as those of the urethra, throat, or eyelids, are attended by symptoms indicative of local distress; such as pain in the back and in the groin, and more especially in the left groin, with dysmenorrhœa, and much sympathy with constitutional irritation, terminating in impatience, malnutrition, and anemia. It is in this condition of the system that many of the so-called hysterical affections are so apt to arise, and the will often find that the most inveterate cases of neuralgia of the face, of the spine, the hip, or the breasts, and of amaurotic and other obscure affections connected with nervous irritation, are primarily dependent on chronic disease of the uterus; and it is only by attacking and removing this, that he will be able to remove the secondary mischief. On examining the condition of the cervix uteri in these cases by means of the speculum, various morbid changes may be observed in them; the cervix is perhaps thickened, indurated, or inflamed on one side; the os is frequently patulous; and the mucous membrane lining these parts will be observed to be erythematous, congested, and excoriated, not unfrequently in a granular condition, closely resembling what may be observed in some forms of granular conjunctivitis. In some cases, again, true ulceration may exist both upon the cervix and within the os. These ulcers, abrasions, excoriations, or by whatever term they may be designated, are unquestionably a fruitful source of mischief in this disease, giving rise to considerable thickening of subjacent structures, and to abundant mucopurulent discharge and much sympathetic constitutional irritation. In their character, they closely resemble corresponding forms of disease met with on the mucous surface in other situations, not attended by loss of structure, but by the development of small pointed granulations or papule, from which the discharge is poured forth.

The Treatment of these various affections of the uterus has been much simplified since their pathology has been better understood, and practitioners are now generally agreed as to the necessity of the employment of local measures for the removal of these morbid states. To the various

is in the habit of managing local disease on other mucous surfaces, and of removing the structural lesions that result from chronic inflammation in other organs, the treatment of these cases can present little difficulty, as it is conducted on precisely the same principles that guide him in the management of similar affections elsewhere.

The employment of caustics is of essential service in these various forms of chronic uterine disease. In cases of simple ulceration or excoriation, the nitrate of silver in stick, applied every third or fourth day, will frequently be found to effect a speedy cure. For this purpose, the hinge caustic-holder will be found an useful instrument (Fig. 517). If there be much chronic



Fig. 517.—Caustic holder.

induration, conjoined with the affection of the mucous membrane, the potassa cum calce, fused into narrow sticks, may very advantageously be used. In doing this, however, care must of course be taken that the cauterising action do not extend too far. Hence the surgeon, after lightly touching the diseased part, whether this be on the cervix or inside the os, should immediately inject some weak vinegar and water, so as to neutralise the alkali. After these applications, which should only be repeated at lengthened intervals, the patient must be kept quiet for some time; and any inflammatory symptoms that may be excited must be combated in the usual way, it very rarely happens, however, that anything untoward will result.

After the removal of the local disease in the way pointed out, any remaining congestion may be got rid of by the application of leeches to the cervix. During the time when these local measures are being adopted, recourse must be had to proper constitutional treatment, with the view of improving the general health on ordinary medical principles. The details of this treatment need not be given here; but for a full exposition of them, as well as for a vast deal of important information on the surgical management of uterine affections, I would refer the reader to the last edition of Dr. H. Bennet's work on the Uterus.

UTERINE DISPLACEMENT.—The various displacements to which the uterus is liable, whether downwards, constituting *Prolapsus*, or in the direction of the axis, being twisted, and either *Retroverted* or *Anteverted*, are causes of much local suffering and constitutional disturbance, and commonly require surgical treatment. These various conditions will frequently be found dependent on inflammatory congestion of the fundus, in consequence of which the organ becomes, as it were, top-heavy, and is tilted to one side, or descends bodily in the pelvis.

The *Treatment* in such circumstances must have reference to the removal of the local turgescence by the application of leeches, the employment of astringents, hip-baths, and the recumbent position; occasionally assisted perhaps, in twist of the organ, by attempts at replacing it by introducing the uterine sound into its cavity, or, when it is prolapsed, by supporting it with appropriate pessaries and the abdominal bandage.

VAGINAL DISCHARGES of a purulent character not unfrequently occur in young female children, as the result of constitutional debility or strumous derangement. Occasionally such discharges lead to the suspicion of the child having been improperly tampered with; and, although they might of course be occasioned by some violence inflicted on the genitals, or even from gonor-

rheal infection, it must be borne in mind that, in the great instances, they certainly arise from constitutional conditions solely in no way referable to external causes. The *Treatment* consists in cleanliness, the use of warm lead lotions, and the improvement of general health.

TUMOURS OF THE UTERUS are of various kinds. The most common are those of a *Fibrous* character. These are often of considerable size, have been found weighing many pounds; they may occupy almost any part of the uterus, either projecting into the peritoneal cavity, occupying the whole of the organ, or dependent into the vagina. These tumours seldom occur in the age of thirty or forty, and are not very amenable to *Treatment*. In some cases, however, considerable benefit results from attention to general health, occasional application of leeches to the cervix, so as to lessen the tension of the organ, and the introduction into the vagina every night of a tampon composed of equal parts of strong mercurial ointment, wax, and lard, containing iodine or the iodide of lead, with the view of acting as an absorbent on the morbid tissue.

Polypi are not unfrequently met with, growing from the inner surface of the uterus, usually from its posterior aspect or fundus. They are generally oval or pyriform, smooth, hard, and insensible, and are attended by repeated hemorrhage; and it is a remarkable fact that in many of the most violent bleeding proceeds from the smallest tumours. In some of the tumours of the uterus are of a soft fibro-cellular, vesicular, or spongy character, attended, like the harder ones, by free hemorrhage.

The *Treatment* of polypi of the uterus is best conducted by ligature of the pedicle. This may usually be readily enough effected by means of a suture or ligature applied by Gooch's double cannula, which has been variously modified, and a good deal improved by different surgeons. The ligature gradually tightens, and usually cuts its way through in from ten to fifteen days; the tumour swells, and decomposes often with a good deal of discharge, which requires to be carefully syringed away by means of chlorinated lotions. It is an useful precaution, not to apply the ligature near the uterine end of the pedicle; as cases have occurred in which, in so doing, the surgeon has given rise to serious and even fatal inflammation of the womb. Any portion of pedicle that is left will gradually be absorbed.

Cauliflower Excrescence from the uterus, attended by copious hemorrhage, is a rare and dangerous affection. The only *Treatment* that is to be of any avail, is to draw down the neck of the uterus by a vulsellum, and then to excise the tumour with the surface of the scalpel. This operation is not attended by any very serious hemorrhage, and succeeds in ridding the patient effectually of her disease.

Malignant Affections of the Uterus usually commence in the form of a scirrhous tubercle or ulceration of the cervix, attended by the usual constitutional symptoms of this affection; there is much offensive discharge, and cancerous cachexy speedily sets in.

The *Treatment* of these cases must be of a purely palliative character, consisting in the administration of opiates and the use of chlorinated lotions, the latter principally relied on. Excision of the diseased cervix has been recommended, and was formerly a good deal practised; but this is a barbarous and contrary to every principle of good surgery, as it is impossible to cure a patient of scirrhous disease by the partial removal of the affected part. Its complete extirpation cannot be thought of. Tumours, however, of a simple character requiring removal are occasionally met with springing from the cervix.

the cervix; they may be excised by putting the patient in the position for lithotomy, drawing the uterus well down with forceps, and removing them with the knife. This has been done during pregnancy, and even during parturition, with good effects.

OVARIAN TUMOURS AND DROPSY.

Ovarian tumours of a cystic character are commonly met with. The cysts may be uni- or multi-locular, and vary greatly in the nature of their contents. These may be either solid or fluid—often a combination of the two. If fluid, the liquid is usually more or less viscid, albuminous, dark and variously coloured. Ovarian tumour invariably ends fatally; in some cases rapidly, in most gradually, occupying many years in its course.

DIAGNOSIS.—It is not my intention to enter into the difficult subject of the diagnosis of ovarian tumours. From pregnancy, ascites, tumours of the uterus and omentum, enlargements of the liver, kidney, spleen, and stomach, hydratids, hysterical tympanitis, fat in the omentum, stercoraceous accumulations, distension of the bladder, spinal curvature, abdominal and pelvic abscesses, the diagnosis has carefully to be made; and that this is a matter of no slight difficulty, is evident from the numerous cases in which errors have happened and are constantly occurring to most experienced practitioners. It is impossible for the surgeon to be too cautious in effecting a diagnosis before he proceeds to open the abdominal cavity in any supposed case of ovarian disease. There is, however, one form of disease that so closely resembles an ovarian cyst, that I may refer to it; it is a *dilated state of the Fallopian tube, containing fluid*—in fact, dropsy of that tube. This condition may generally be recognised by the tumour being of moderate size, wholly fluid, having deep pelvic adhesions, displacing the uterus and bladder, and drawing up the vagina into a pouch. The displacement is often very remarkable and considerable. I have seen the bladder flattened out and drawn up as high as the umbilicus—the top of the vagina above the pubes. In these cases, the abdominal wall is not so much thinned and expanded as in true ovarian disease. The tumour, which cannot of course be extirpated, is never pediculated.

TREATMENT.—The treatment of ovarian tumour may be conducted:—1, by Medical Means; 2, by Tapping; 3, by Tapping, conjoined with Auxiliary Measures; 4, by Injection; 5, by Extirpation.

1. MEDICAL MEANS exercise no influence in curing ovarian tumours, and but little, if any, in retarding their progress. Specific treatment by means of mercury or iodine has always appeared to me to hasten the progress of the malady, by breaking down the constitutional powers of the patient; and attempts at promoting the absorption of the fluid by purgatives, diuretics, &c., are invariably unsuccessful. An ovarian cyst is a parasitic growth, the tissues of which are not influenced to increased power of absorption by the action of deobstruents on the system generally. The utmost that can be done by medical means in such cases is, to attend to the general health and to support the patient's strength by tonics.

2. TAPPING in ovarian dropsy may be done as for ascites, through the linea alba; but not unfrequently the tumour presents more distinctly at some other part of the abdominal wall, and may be emptied through the linea semilunaris; or, if multilocular, it may require the trochar to be inserted at different points into its separate compartments. The paracentesis of ovarian cysts should, unless the disease be very acute, always be deferred as long as is compatible with the comfort of the patient; as it is not only followed by speedy reaccumulation of the fluid, and often by rapid exhaustion, few patients surviving the first operation more than three or four years; but is

attended by certain special danger, exhaustion, or possibly even of the small intestine, which is sometimes ovarian cyst, and may be met with.

3. TAPPING, CONJOINED WITH A CAUTERY, has succeeded in effecting a cure of the various kinds:—firm pressure; incision of its wall, plugging the aperture in the catheter or tube; the establishment of a communication with the interior of the cyst, either through the vagina, have all been adopted. Much these different procedures rest on one principle; viz., that of causing the rupture and the cohesion of its walls—a principle applicable to unilocular cysts, and has been successful in a number of cases, and those the same means can be looked upon as concerned. By means of them the cyst collapses and contract. But secondly, the base, and whose development has been arrested, and absorption of nutrition by the cyst, when this has been reduced in size, the tumour may be substituted for an

4. INJECTION OF TINCTURE OF IODINE, has been employed both in this country and abroad. It has been tapped, from four to six ounces, and through a catheter passed down the vagina. The effect of this injection is the contraction of the cyst, the effusion of plastic matter with the cyst, and disturbance follows; in others, a violent iodism, the urine and saliva become loaded with iodine; in others again, suppuration of the cyst follows. This method of treatment is only applicable to unilocular cysts: and in them it must be looked upon as a temporary measure—the cyst collapsing, and the tumour being removed.

5. OVARIOTOMY.—Ovarian cysts have been removed on account of their large size and the danger to life by them, or from their rapid growth, and the want of a speedy extinction of life. To the merit of having introduced and performed this operation was first proposed by John Bell, and was first performed in Kentucky. The first operation was done by Lizars, in 1823. From that time to the present it has, after various fluctuations in its estimation, as an established surgical operation, been performed by Spencer Wells, and Tyler Smith. Amongst practitioners as to the propriety of the operation has been chiefly condemned on two grounds:—first, that it is not compatible with long life, it is not a safe procedure for its removal; and, secondly, that it is so high as not to justify a surgical

With regard to the first objection, it may be stated that ovarian disease is attended by very great discomfort and inconvenience in all cases; that it prevents a woman from discharging the active duties of life, and, amongst the poorer classes, from obtaining a livelihood; and that, so far from being a comparatively innocuous affection, it wastes and enfeebles the patient, interfering seriously with nutrition, and with the actions of the abdominal or pelvic organs, and is not generally compatible with prolonged existence. Dr. Lee states that about 80 per cent. of the cases that are not operated upon, die within one year and three quarters after the appearance of the disease. When it grows rapidly, or so soon as it attains such a size as to require tapping, death takes place much more quickly. Mr. Safford Lee states that of 46 patients with ovarian disease, who were tapped, 37 died, and only 9 recovered; and that of the 37 who died, more than one-half did so in four months from the first tapping, and 27 out of the 37 within a twelvemonth, and of these 18 were tapped once only. In those who survive, repeated tapplings are required at constantly decreasing intervals.

The second objection can have little weight with any practical surgeon. The mortality after ovariectomy is not so high as that after many operations, which no surgeon would hesitate for a moment in performing. It is true that in some of these cases, as in the ligation of the larger arteries for aneurism, speedy death would be the penalty of non-interference; whereas, in ovarian disease, a miserable existence may be protracted for some months after the tumour has attained so great a bulk as to render surgical aid necessary. But in other surgical diseases in which operations of the gravest character are performed without hesitation, as in the removal of the upper jaw for tumour, or in amputation at the hip-joint for tumours of the femur, the same objection would hold good. The diseases for which these great and dangerous operations are performed, are not incompatible with some months or even years of painful existence; yet the surgeon does not hesitate to give the patient the chance of a doubtful recovery, in order to extricate him from the miseries of prolonged suffering. It is not necessary, in order to justify an operation even of a dangerous character, that the patient be in immediate peril of death. It is sufficient that the death from the disease which it is proposed to remove should ultimately be certain, though it may be delayed by months or years of previous suffering. From this point of view Ovariectomy appears to me to be a perfectly proper and justifiable operation, and it presents the advantage of the cure, if practised, being complete and permanent. In it there is no mean; the death is speedy, or the cure complete.

Mr. John Clay of Birmingham, in the appendix to his translation of Kiwisch's *Chapters on Disease of the Ovaries*, has collected from various sources the particulars of 567 cases. Of these, the operation was completed by the removal of the entire ovarian tumour in 425, or about three-fourths; the mortality being 183, or about 43 per cent. In 24 cases, the tumour was only partially removed; of these 14 died. In 13 cases, extra-ovarian (mostly uterine) tumours were removed; the mortality here amounted to 10. Of 105 cases in which the operation was abandoned, there were adhesions in 83; and in 23 the disease was mostly extra-ovarian, while in a few no tumour was found. Amongst these 105 abandoned cases, 27 died. The results of ovariectomy in the hands of those who have most extensively practised it of late years—as Baker Brown, Tyler Smith, and Spencer Wells—is, however, even more favourable than these.

The mortality after ovariectomy appears to be increased by the existence of adhesions. When these complicated the operation, in those cases in which

the ovarian tumour was completely removed, 49 per cent. of the cases when they did not exist, 32 per cent. were fatal.

When we compare these returns, not only with the mortality which follows operations of immediate urgency—as primary amputation of the limb for injury—but with that which attends great operations for disease which might be palliated and in which existence might be protracted for a little time—as amputation at the hip-joint for tumour, or the division of the innominate and subclavian arteries for aneurism, or even the extraction of vesical calculus of large size by lithotomy in the female, we cannot consider the mortality after ovariectomy so great as to influence the performance of the operation, if other circumstances justify it.

It has further been objected to Ovariectomy, that it has not unfrequently happened that, after the operation has been commenced, it has been impossible to complete it, owing to the existence of adhesions between the tumour and the contents of the abdomen. This objection is certainly well founded; but I believe that, with care in examining the tumour, and ascertaining its mobility during respiration, the existence or absence of such adhesions, the position of the abdominal wall during the respiratory movements, the free connection with the uterus, as determined by finding that organ by the introduction of the uterine sound, and the previous non-existence of peritonitis, this mistake is not now so likely to happen as formerly, and the liability to it was not suspected.

OPERATION.—On the day preceding the operation a dose of castor-oil should be administered, and on the morning of it an enema, so that the bowels may be completely emptied. The room having been warmed to a temperature of at least 70° F., chloroform administered, and the patient emptied by the catheter, the patient must be placed upon a table with blankets, in such a way that the legs hang over the end of the table, and the abdomen is fairly and evenly exposed. The surgeon, taking care between the patient's legs, makes an incision, usually about six inches in length, from the umbilicus downwards, directly in the middle. With a few touches of the knife, the structures, which are usually much adherent, are divided along the linea alba, and the abdominal cavity is opened.

There has been much discussion as to the length to which the abdominal wall should be made; some practitioners recommending that this should be of very limited extent, others that it should reach ensiform cartilage to the pubes. No definite rule can be laid down at this point. The incision must be proportioned in extent to the nature of the tumour, and the existence or absence of adhesions. If the tumour be cystic and unilocular, and not adherent, it may be readily extracted by making an incision only an inch or two in length in the middle, tapping it through this, and then drawing the emptied cyst for the means of a vulsellum. If, on the other hand, the ovarian growth be solid, a larger incision, from four to six inches in extent, will be necessary. Should adhesions exist, it may even be necessary to go beyond the umbilicus. I cannot believe that it is ever necessary to rip up the abdominal wall from the sternum to the pubes, for the removal of any tumour, however adherent. In making this incision, the surgeon must be careful to divide the peritoneum fairly, and not to mistake it for the cyst-wall, and to cut off the abdominal muscles.

The tumour now comes into view; if cystic, it must be tapped with a long trocar, and the fluid evacuated. Especial care should be taken not to allow this viscid ovarian fluid to escape into and flood the abdominal and pelvic cavities. This may often be avoided by conducting

from the patient, by means of a vulcanised India rubber tube attached to the cannula. In this way, the size of the tumour may be so much lessened as to admit of its more ready extraction. If cystic, and emptied, it may now perhaps be drawn out through the incision in the abdominal wall without further difficulty. If it be solid, or if there be any adhesions, the surgeon must introduce his hand, and by sweeping it round the tumour assist in removing the mass. The chief difficulty in the operation will consist in the presence of adhesions. Should none exist, nothing can be simpler than the extraction of the tumour, which has a tendency to protrude forwards into the wound. Should they be slight and confined to its anterior part attaching this to the abdominal wall, they may readily enough be broken through by the hand being swept round the forepart of the tumour. If they be firm, deep, and extensive, then the real difficulty of the operation will have to be encountered. It is, however, important to observe that adhesions of this kind will chiefly be found at the anterior part, between the tumour and the abdominal wall; comparatively seldom posteriorly, or connected with any of the abdominal viscera, except the uterus. If possible, these adhesions should not be cut across, as they often contain vessels that would bleed freely if so divided; but they should rather be torn—no slight force occasionally being required to detach them. Should the tumour be so closely adherent to any viscus that its separation is attended with danger, it might be safer to cut across the cyst-wall, and leave the adherent portion of this, than to run the risk of laceration of the liver or intestine. During the withdrawal or protrusion of the mass from the abdomen, an assistant on each side must press gently upon the sides of the incision with the hands or with soft napkins, so as to prevent the protrusion of the intestines, which, if possible, should not be seen during the operation. The tendency to intestinal protrusion sometimes occasions considerable trouble; especially if the patient have taken chloroform and begun to vomit, when it may be necessary to discontinue the operation for a time.

The separation of the pedicle is the next step, and perhaps the most important one in the operation. In order to do this securely, some surgeons fix the pedicle by means of a clamp, and then cut it across above this instrument. To this there can be no objection, if the pedicle be long and narrow; but if it be short and thick, great inconvenience may result by the clamp either being drawn down into the pelvic cavity, or the pedicle and pelvic organs being drawn upwards to a painful and perhaps dangerous extent. I prefer tying with a whipcord ligature. This may best be done by drawing the tumour well forwards, transfixing the pedicle with a *navus*-needle carrying a strong whipcord ligature, tying this firmly on each side, and then cutting it across above the constricted portion. In doing all this, a few points require attention. Care should be taken that the needle does not transfix any large artery or vein. This may generally be avoided by spreading out or unravelling, as it were, the pedicle, and examining its structure before passing the ligature. After it has been transixed, and before the cord is tied, it is well to dissect off that portion of the peritoneal investment of the pedicle which corresponds to the line that will be constricted by the ligature. In doing this, great care must, however, be taken not to wound the vessels, especially the veins, which are very thin-walled. In this way there will, I think, be less risk of peritonitis, as there is less chance of any slough of the pedicle falling into the peritoneum, and I attribute to the adoption of this precaution much of the success that attended the removal of an ovarian tumour, partly solid and partly cystic, weighing about fifteen pounds, which I extracted from a lady, sixty-five years of age.

After its ligature, the pedicle shows the part tied. If it be cut across near the stump retracting under it, and caused 16 per cent. of the deaths after.

The next point in connection with of the peritoneal cavity, so that always has a tendency to do, and in presence of the ligatures and results look upon this fixing of the pedicle as of the most important steps of the more immediately depends than on a convenient way to fix it is to close the minimal wall by a hare-lip pin passed at an angle, and, drawing the stump of, through this, to retain it there in which it has been tied, in the usual this way it cannot possibly be retracted the slough or ligature falling into the

The incision in the abdomen made from within outwards, or by a series of lip to the other, at intervals of 1/2 inch. Pins should be passed deeply, not only through the integuments and muscles, but also through the sutures are passed round these in the same way to pin. In this way the whole line is supported. The abdominal wall must be covered with long slips of plaster, and a laced napkin.

Should it unfortunately be found that adhesions exist, so close and extensive, the wound in the abdominal wall must be treated as in the successful

The *after-treatment* of the case is very different although it presents nothing of a very serious nature. The management of ordinary abdominal inflammation is headed are from peritonitis, exhaustion, and shock. Peritonitis requires to be more carefully treated: of 150 fatal cases, it caused 100 per cent. The patient should be kept in bed. Nothing but ice and barley- or Seltzer water should be allowed for several days; and opium should be given in sufficient and repeated doses to relieve him by it. The urine must be drawn off by catheter. The bowels should be left unrelieved, and merely opened by an enema. As in the case of the whole of this time, little inconvenience is caused. Should a strangulated hernia be present, the patient must be kept up by the irritable state of the stomach with

After recovery from ovariectomy, the disease, even when colloid, is cured through the medium of the ovary and is accomplished.

INDEX.

ABDOMEN, contusions of, 399
 emphysema of walls of, 401
 injuries of, 399
 symptoms of, 400
 treatment of, 402, 404
 tapping the, 1032
 wounds of, 402

Abscess, 37, 414
 acute, 414
 treatment of, 419
 boundary membrane of, 38
 causes in, 421
 chronic, 415
 treatment of, 419
 cold, 415
 congestive, 415
 diagnosis of, 417
 from aneurism, 500
 diffuse, 416
 drainage of, 421
 effects of, 416
 emphysematous, 416
 formation of, 37
 incision in, 419
 lymphatic, 415
 metastatic, 416
 phlegmonous, 414
 prognosis of, 418
 puerperal, 416
 pyæmic, 463
 situation of, 416
 size of, 416
 structure of, 38
 tapping of, 421
 treatment of, 418
 tympanic, 416
 varieties of, 414

Abscess of antrum, 370
 near anus, 1045
 of areola, 939
 in axilla, diagnosis from aneurism, 651
 Hilton's method of opening, 420
 of bone, 705
 breast, 939
 bursa patellæ, 317
 in caries of spine, 788
 diagnosis of, 789
 from sacro-iliac abscess, 796
 frontal sinuses, 553
 groin, 789
 diagnosis from aneurism, 663, 790

Abscess (continued).
 in groin, diagnosis from fatty tumours, 790
 from femoral hernia, 790, 1013
 from inguinal hernia, 1004
 of gumæ, 867
 in hip disease, 799, 802, 803, 807
 diagnosis from abscess near hip, 790
 from spinal abscess, 790
 iliac, 789
 diagnosis from spinal abscess, 790
 ischio rectal, 1045
 in and near joints, 740, 741, 745
 near larynx, 902
 mammary, 940
 in neck, diagnosis from aneurism, 629
 nose, 854
 diagnosis from polypus, 857
 perineal, 1153, 1156
 popliteal, diagnosis from aneurism, 671
 postpharyngeal, 886
 dysphagia from, 887
 prostatic, 1143
 psoas, 788
 diagnosis from femoral hernia, 1013
 sacro-iliac, 795
 diagnosis of, 796
 submammary, 939
 supramammary, 939
 of testis, 1233
 tongue, 878
 urethral, 1152
 urinary, 1156

Absorption, interstitial, a result of in
 flammation, 67, 68
 of lymph, 84

Acetabular exalgia, 302, 310

Acetabulum, a, disease of, 310
 excision of, 310
 fracture of, 267

Acromion, dislocation of clavicle on, 297
 under, 298
 fracture of, 255

Acupressure, 156

Acute abscess, 414
 inflammation. *See* Inflammation.

Adenitis, 569

- Adenoid tumour of breast, 942
- Adhesion, primary, 110
 - of wounded arteries, 161
- Adhesions in hernial sac, 967
 - management of, 391
- Adhesive arteritis, 569
 - inflammation, 83, 110
 - phlebitis, 563
- Adipose tumours, 476. *See* Fatty tumours.
- Aduster, Jarvis's, 288
- Aerial fistula, 378
- Air in veins, 201
 - causes of, 202
 - effects of, 201, 202
 - experiments on animals regarding, 201
 - spontaneous entry of, in man, 20
 - treatment of, 204
- Air-passages, foreign bodies in, 379
 - auscultatory signs of, 380
 - inflammation from, 380
 - irritation by, 380
 - obstruction by, 379
 - operations for removal of, 381
 - prognosis of, 379
 - treatment of, 382
- introduction of tubes into, 896
- operations on, 923
- wounds of, 378
 - effects of, 376
 - situations of, 376
 - treatment of, 377
- Ala nasi, restoration of, 908
- Albuminous effusions, 82
 - serous, 479
- Albuminuria, arthritis in, 740
 - in relation to lithotomy, 1097
- Allarton's operation, 1161
- Alopaea, sy, lithic, 539
- Alternating calculus, 1063
- Alveolar cancer, 487
 - processes, diseases of, 867
 - neurosis of, 719, 868
- Amputations in general, 18
 - for ankylosis, 752
 - aneurism. *See* Aneurism
 - in bones, 132
 - cancer of bone, 781
 - caries, 769
 - conditions affecting result of, 28
 - in contused and lacerated wounds, 118
 - for disease, 30
 - dressing after, 23
 - erysipelas after, 23
 - by flaps, 20, 23
 - in fractures, 233, 234, 235, 241
 - fracture, 153
 - gangrene, 118, 185, 241, 435
 - gun-shot wounds, 131
 - hemorrhage during, how prevented, 22
 - secondary, after, 181
 - for injury, 29
 - instruments for, 20
 - in joint disease, 783

- Anæmia** from hemorrhage, 157
Anæsthesia, 9. *See* Chloroform.
 local, 15
Anastomosing vessels, enlargement of
 after ligature, 177
Anchylolysis, 751
 of arm, 834, 835
 complete, 751
 complicating fracture, 234
 of elbow, 834
 excision for, 763
 fibro-cellular, 751
 in lip disease, 800
 incomplete, 751
 of knee, 840, 843
 osseous, 751
 treatment of, 752
Anel's operation for aneurism, 596
Aneurism in general, 579
 accidents after operation for, 600
 age, how influenced by, 579
 amputation for, 599, 603, 605, 649,
 660, 673, 676
 by anastomosis, 650
 diagnosis of, 680
 treatment of, 681
 in tongue, 878
 arterio-venous, 189, 615
 atheroma a cause of, 579
 blows a cause of, 580
 of bone, 732
 cachexy a cause of, 580
 causes of, 579
 circumscribed, 583
 symptoms of, 587
 classification of, 581
 chronic, how influenced by, 580
 death from, how produced, 592
 definition of, 579
 diagnosis of, 589
 from aneurism by anastomosis,
 680
 osteocancer, 731
 osteoneurism, 734
 diffused, 583
 symptoms of, 588
 dissecting, 583
 classes of, 584
 duration of, 587
 effect of ligature on, 597
 false, 582
 circumscribed, 583, 587
 diffused, 583, 587
 fatty degeneration a cause of, 579
 formation of, 584
 fusiform, 581
 gangrene in, 585, 588, 605
 muscular strain a cause of, 581
 number of, 586
 pressure effects of, 585
 recurrent pulsation in, 600, 602
 rupture of, 592
 sacculated, 582
 false, 582
 true, 582
 secondary, 600, 602, 676
 spontaneous cure of, 591
Aneurism (*continued*).
 structure of, 584
 of stumps, 27
 suppurating and sloughing of, 592, 603
 symptoms of, 587
 terminations of, 591
 traumatic, 186
 circumscribed, 187
 diffuse, 186
 complicating fracture, 232
 treatment of, 593
 by compression, 607
 constitutional, 593
 by digital compression, 613
 flexion, 612
 galvano-puncture, 614
 injection, 615
 ligature, 595. *See* Ligature
 manipulation, 613
 tubular, 581
 varicose, 189
 wounds of arteries a cause of, 581
Aneurisms, Special, 616
 of anterior cerebral artery, 637
 aorta, abdominal, diagnosis from
 abscess in groin, 790
 aorta, thoracic, 616. *See* Aneur-
 ism, intrathoracic
 arm, 661
 axillary artery, 650
 diagnosis of, 651
 inflamed, 656, 659
 symptoms of, 650
 traumatic, 193
 circumscribed, 195
 diffuse, 194
 from attempt to reduce
 old laceration, 305
 treatment of, 651
 basilar artery, 637
 brachial artery, 661
 traumatic, 196
 varicose, 197
 brachio-cephalic artery, 619. *See*
 Aneurism of Innominate
 Artery
 carotid artery, 627
 diagnosis of, 628
 dysphagia produced by, 887
 frequency of, 627
 interim, 636
 extracranial, 636
 intracranial, 637
 symptoms of, 623
 traumatic, 192
 treatment of, 630
 femoral artery, 663, 670, 671
 deep, 671
 traumatic, 199
 varicose, 199
 foot, traumatic, 200
 gluteal artery, 669
 traumatic, 200
 iliac artery, external, 663
 internal, 669
 inguinal 663
 diagnosis of, 663

- Aneurisms, Special (continued)**
 syphilitic of, 603
 treatment of, 603
 of innominate artery, 619
 dysphagia from, 688
 ligature for, 622
 pressure-effects of, 620, 688
 prognosis of, 621
 symptoms of, 619
 treatment of, 621
 intracranial, 637
 causes of, 637
 death from, 640
 frequency of, 637
 pathology of, 637
 pressure-effects of, 638
 symptoms of, 639
 treatment of, 641
 intraorbital, 642
 intrathoracic, 616
 auscultatory signs of, 616
 dysphagia from, 618
 dyspnea from, 617
 oedema from, 618
 pressure-effects of, 616
 pulsation and tumour in, 618
 of palmar arteries, traumatic, 198
 plantar arteries, traumatic, 200
 popliteal artery, 671
 aneurysm of, 671
 diffuse, 676
 amputation in, 676
 treatment of, 676
 double, 676
 symptoms of, 671
 treatment of, 671
 popliteal artery, 662
 radial artery, traumatic, 107
 sciatic artery, 669
 subclavian artery, 643
 aneurysm of, 649
 diagnosis, 643
 ligature of brachio-cephalic artery for, 644
 subclavian, 646
 symptoms of, 643
 traumatic, 193
 treatment of, 643
 temporal artery, traumatic, 192
 tibial artery, 679
 ulnar artery, traumatic, 197
 vertebral arteries, 637
Aneurismal aneurysm, 482
 diathesis, 586
 varix, 189, 615. *See* Varix
Angerleucitis, 559
Animal matter, decomposing, erysipelas from, 447
 wounds inoculated with, 143
Ankle, amputation at, 44
 dislocation of, 325
 excision of, 780, 783
 fractures near and through, 282
 gunshot wounds of, 133
 weak, 448
 wounds of, 214
Annular calcification in arteries, 574
Antiphlogistic in acute contraindicated in
 treatment of, 75
 in aneurysm, 90
 in chronic inflammation
Antiseptics in gangrene
Antrium, diseases of, 570
 dropsy of, 570
 suppuration of, 570
 tumours of, 571
 treatment of, 571
Arms, abscess near, 100
 absence of, 1034, 1035
 artificial, 204, 1020
 formation of, 1034
 by Amputation, 1034
 in children, 1034
 by Laceration, 1034
 by Pressure, 1034
 treatment of, 1034
cancer of, 1040
 changes in, 1038
 closure of, 1034
 by amputation, 1034
 with blood, 1034
 congenital malformation
 fissure of, 1043
 fistula of, 1046
 imperforate, 1024
 operations on, 1034
 narrowing of, 1034
 prolapse of, 1034
 spasmodic contraction
 ulcers of, 1043
Aorta, aneurysm of. *See* Aneurysm
 ligature of, 663
 wounds of, 398
Aphonia, 895
Apical growths, 456
Atlastic lymph, 83
Apoplexy, dangerous to
 coma, 328
 from intracranial aneurysm
Arachnitis, exophthalmic
 traumatic, 365
Areola, abscess of, 939
 inflammation of, 939
Arm, amputation of, 37
 aneurysm of, 524
 aneurysm of vessels of
 arteries of, wounded,
 contraction of and
 deformities of, 524
 fractures of, 256
 gangrene of, after
 res. 658
Arnica in contusions, 100
Arnott, Dr J., cited as author
 in cancer, 421
Arsenic in cancer, 423
Arteries, compression applied
 adhesive process in, 10
 aneurysm of. *See* Aneurysm
 atheroma of, 572

Arteries (continued).

- calcification of, 574
 - gangrene from, 431
 - canterisation in wounds of, 164
 - congestion in wounded, formation of, 180, 175, 179
 - cold in wounds of, 164
 - contraction of, 160, 161, 570, 577
 - contusion of, 154
 - degenerations of, 572
 - a cause of aneurism, 579
 - diseases of, 569
 - effect of abscess on, 416
 - effects of ligature on, 174
 - embolism of, 430
 - enlargement of, in inflammation, 59
 - fatty degeneration of, 572, 579
 - gangrene from obstruction of, 183, 429, 430, 571
 - granular degeneration of, 572
 - hemorrhage from, 156
 - characters of, 156
 - effects of, 156
 - natural arrest of, 158
 - in sloughing phagedena, 440
 - surgical treatment of, 162, 440
 - inflammation of, 569. *See* Arteritis
 - injuries of, 154
 - in contused wounds 115, 120
 - in fracture, 232, 236
 - in gunshot wounds, 126, 123
 - in lacerated wounds, 115, 120
 - ligature of. *See* Ligature.
 - in stumps, 22
 - occlusion of, by disease, 569, 570, 577
 - by natural processes, 158
 - after operation, 174
 - permanent closure of wounded, 161
 - plastic deposits in, 573
 - pressure in wounds of, 165
 - punctured, 162
 - resistant to sloughing, 179
 - retraction of, 159
 - rupture of, 154
 - spontaneous, 577
 - in sloughing phagedena, 438
 - state of, in inflammation, 59
 - structural diseases of, 572
 - causes of, 575
 - effects of, 576
 - styptics in wounds of, 164
 - tension of, 165
 - ulceration of, 577
 - wounds of, 155
 - in compound fracture, 236
 - gangrene from, 429
 - in hernia operations, 993
 - in lithotomy, 1093, 1103
 - principles of treatment of, 169
 - treatment of, 158
- Arteries or Artery, anterior cerebral,**
 aneurism of, 637
 of arm, wounds of, 196
 axillary, aneurism of, 650. *See* Aneurism
 traumatic, 193
 ligature of, 193, 195, 660

Arteries or Artery (continued).

- axillary, wounds of, 183
- basilar, aneurism of, 637
- brachial, aneurism of, 661
 - traumatic, 196
 - varicose, 197
- ligature of, 196, 661
- wounds of, 196
- brachio-cephalic. *See* Artery, innominate
- carotid, aneurism of, 627. *See* Aneurism
 - dysphagia from, 887
 - traumatic, 192
- ligature of, 192, 622, 624, 630
- wounds of, 192
- internal, aneurism of, 636
- epigastric, relation to femoral hernia, 1011
 - to inguinal hernia, 1002, 1003
- of face, wounds of, 182
- femoral, aneurism of, 663, 670
 - traumatic, 199
 - varicose, 199
- ligature of, 199, 672
- of foot, ligature of, 689
- wounds of, 200
- femoral, wounds of, 197
- gluteal, aneurism of, 669
 - traumatic, 200
- of hand, wounds of, 197
- iliac, common, ligature of, 666
 - external, aneurism of, 663, 664
 - ligature of, 664
 - internal, aneurism of, 669
 - ligature of, 199, 669
- innominate, aneurism of, 610. *See* Aneurism
 - dysphagia from, 888
 - ligature of, 644
- intercostal, wounds of, 304
- internal carotid, wounds of, 394
- intracranial, aneurism of, 637. *See* Aneurism
- of leg, wounds of, 200
- obturator, relation to femoral hernia, 1012
- ophthalmic, aneurism of, 642
- pachyma, wounds of, 197
 - traumatic aneurism of, 198
- perineal, wounds of, lithotomy, 1003
- perineal, wounds of, 200
- plantar, traumatic aneurism of, 200
- popliteal, aneurism of, 671, 676
- pulse, aneurism of, 669
- radial, ligature of, 197, 662
 - traumatic aneurism of, 197
 - wounds of, 197
- sciatic, aneurism of, 669
- subclavian, aneurism of, 643
 - traumatic, 193
 - ligature of, 194, 622, 624, 646, 648, 652
 - wounds of, 192
- temporal, traumatic aneurism of, 192
- thyroid, ligature of, 660
- tibial, ligature of, 679

- Arteries or Artery (*continued*).
 tibial, posterior, warts of
 ulnar, ligature of, 662
 traumatic aneurism
 wounds of, 197
 vertebral, aneurism of, 632
 Arterio-venous aneurism, 189, 6
 wounds, 189
 Arteritis, 569
 adhesive, 569
 causes of, 569
 closure of artery by, 569, 6
 diffuse, 570
 effects of, 570
 erysipelatous, 569, 570
 gangrene from, 430, 570, 6
 limbed, 569
 symptoms of, 571
 treatment of, 572
 Arthritic coxalgia, 801. *See* H
 Arthritis, 739
 chronic rheumatic, 746
 of hip, 746
 diagnosis of, 748
 pathological changes in
 treatment of, 748
 of jaw, 748
 shoulder, 748
 simple acute and chronic, 7
 causes of, 739
 diagnosis of, 741
 pathology of, 741
 repair after, 744
 symptoms of, 742
 treatment of, 744
 strumous, 749. *See* White
 traumatic, 211
 Artificial angs. *See* Anus, artific
 limbs, 26
 respiration, 356
 Asperma, 1226
 Asphyxia, 384
 from chloroform, 14
 from drowning, 384
 artificial respiration in,
 from irrespirable gases, 388
 from hanging, 388
 secondary, 388
 treatment of, 384, 324
 in wounds of throat, 377
 Asthenic inflammation, 66
 Astragalus, dislocation of, 326
 excision of, 779
 Astringents in inflammation, 80
 Atheroma in arteries, 572
 influence on aneurism, 6
 diagnosis from pus, 68
 Atheromatous tumours, 470
 Atmosphere, influence on erysipe
 Atlas, disease of, 792
 dislocation of, 369
 Atony of bladder. *See* Bladder
 Atrophy of bone, 720
 Auscultatory signs of aortic aneurism
 foreign bodies in bronchi, 380
 Axilla, traumatic aneurism in, 198
 tumours in, 963

Bladder (continued)

- irritable, lithiarity complicated by, 1124
 - after lithiarity, 1116
 - pathological changes in, 1034
 - treatment of, 1136
 - in women, 1137
 - lithotomy through, above pubes, 1108, 1130
 - painful conditions of, 1142
 - polyp of, 1137
 - puncture above pubes, 1150, 1184
 - through rectum, 1150, 1183
 - rectum opening into, 1037
 - rupture of, 408
 - sacculated, 1071, 1077, 1090
 - complicating lithiarity, 1124
 - sounding the, 1074, 1110
 - stone in. *See* Calculus
 - tumours of, 1137
 - wounds of, 408
 - in lithotomy, 1095
- Blepharoplasty**, 906
- Blind fistula**, in ano, 1047
- piles**, 1050
- Blisters** in chronic inflammation, 80
- Blood**, changes of, in arrest of hemorrhage, 159
 - in erysipelas, 446
 - in inflammation, 58, 60
 - in buffy coat in, 61
 - in pyemia, 464
 - effusion of, 82
 - extension of inflammation by, 67
 - extravasation of, 105, 156. *See* Extravasation
 - mixed with pus, diagnosis of, 88
 - sources of, in hematuria, 1138
 - transfusion of, 157
 - vomiting of, in fracture of skull, 346
- Blood-letting**, general, in acute inflammation, 71
- local**, in acute inflammation, 73
 - chronic inflammation, 79
 - gangrene, 99
- Blood-vessels**, enlargement of in inflammation, 69
- formation of in granulations**, 94
- in lymph**, 85
- injury of**. *See* Arteries and Veins
- Blows** a cause of aneurism, 550
- of cancer**, 488
- Bloxam's dislocation tourniquet**, 288
- Boils**, 441
 - causes of, 441
 - diagnosis from carbuncles, 443
 - syphilitic, 539
 - treatment of, 442
- Bone**, abscess of, 705
- aneurism of**, 732
 - diagnosis of, 733
 - symptoms of, 733
 - treatment of, 784
- atrophy of**, 720
- bending of**, 209
- bruising of**, 209
- cancer of**, 729

Bone (continued)

- diagnosis of, 730
 - from osteo-aneurism, 734
 - treatment of, 731
 - caries of, 707. *See* Caries
 - diseases of, 703
 - effect of aneurism on, 586
 - encephaloid of, 733
 - diagnosis from osteo-aneurism, 734
 - enchondroma of, 727
 - fracture of, 214. *See* Fracture
 - hydratis in, 728
 - hypertrophy of, 720
 - injuries of, 209
 - inflammation of, 703
 - neuritis of, 710. *See* Neuritis
 - re-breaking of, 242
 - scrofulous disease of, 507, 720
 - softening of, 721
 - structural changes in, 720
 - suppuration of, 704
 - acute, 704
 - chronic, 705
 - syphilitic disease of, 548
 - trephining of, 706
 - tubercle of, 723
 - tumours of, 726
 - cystic, 727
 - malignant, 729
 - pulsating encephaloid, diagnosis from osteo-aneurism, 734
 - sanguineous, 732
- Bony anchylosis**, 751
- Bozeman's operation**, 1191
- Brachial artery**. *See* Artery, brachial
- Brachiocephalic artery**. *See* Artery, innominate
- Brain**, aneurism of vessels of, 637
 - compression of, 332, 338, 357
 - by aneurism, 638, 639, 640
 - congestion of, 330, 337
 - congestion of, in fracture, 232
 - deposition of pus on, 335, 339
 - diabetes from injuries of, 355
 - effect of ligature of carotid on, 631
 - extravasation on, 357
 - foreign bodies in, 354
 - removal of, 356
 - hernia of, 356
 - congenital, 349
 - inflammation of, traumatic, 333, 338
 - injuries of, 330, 354
 - treatment of, 337, 356
 - irritation of, 333, 338
 - laceration of by contre-coup, 354
 - wounds of, 354
- Brasador's operation**, 598
- Breast**, abscess of, 939
- chronic**, 941
- absence of**, 936
- adenoid tumour of**, 942
- amputation of**, 946, 981
- anomalies of development of**, 936
 - of secretion of, 937
- cancer of**, 943
 - causes of, 952

treatment of, 947

tumours of, 944

 cervical, 945

 conical, 946

 mammary, 946

diseases of, 945

 in male, 953

eucyphaloid tumour of, 951

hydatidic, 949

hypertrophy of, 937

inflammation of, 938

 scars of, 939

 treatment of, 940

lactal tumours of, 948

malignant tumours of, 948

neuritis of, 944

non-malignant tumours of, 942

painful tumour of, 944

recurrent fibrous tumour of, 948

sanguineous cysts in, 948

scirrhous of, 949

 duration of, 951

 effect of, 949

 stricture of, 951

sero-cystic tumour of, 944

suppurative, 936

tumours of, 942

Brilles, 96

Bright structures, 1186

Bronchi, foreign bodies in, 379

 pressure of aneurism on, 617

Bronchitis, asthmatic, 77

 from foreign bodies, 380

 in wounds of throat, 377

Bronchiole, 865

 cystic, 865

 extension in, 866

 ligature of thyroid arteries in, 866

 pulsating, 866

Calculus (continued).

- number of, 1070, 1077
- operations for. *See* Lithotomy and Lithotripsy
- origin of, 1066
- osalty, 1066
- passing, 1073
- phosphatic, 1067, 1068
- physical characters of, 1071
- diagnosis of, 1074
- position of, 1071
 - difficulties from, 1089
- recurrence of, 1126
- relative frequency of, in various countries, 1072
- seizure of, in lithotripsy, 1113
- shape and size of, 1071
 - difficulties from, 1091
- sounding for, 1074, 1110
 - errors in, 1077
- structure of, 1068
- symptoms of, 1073
- varieties of, 1064
- weight of, 1071
- xanthine, 1067
- in kidneys, 1069
- in nasal fossae, 859
- prostatic, 1128
 - characters, 1128
 - treatment of, 1129
- in urethra, 1127
- Jensen's operation for artificial anus, 1029
- callus, 221
 - ossification of, 222
- canalisation of veins, 203
- canellous exostosis, 726
- cancer, 482
 - alveolar, 487
 - anastomosing, 482
 - black, 482, 487
 - causes of, 488
 - caustics in, 492
 - cells of, 483
 - characters of, 482
 - chondroid, 482
 - colloid, 482, 487
 - compression in, 494
 - coagulation of, 491
 - diagnosis of, 488
 - from epithelioma, 501
 - from pus, 88
 - encephaloid, 482, 486. *See* Euccephaloid
 - epithelial, 492, 499. *See* Epithelioma
 - extension of, 495
 - gelatinous, 482, 487
 - hard, 482, 485
 - juice of, 483
 - melanotic, 482, 487
 - microscopic characters of, 483
 - operations for, 491, 498
 - osteoid, 482
 - progress of, 484
 - scirrhous, 482, 485. *See* Scirrhous
 - soft, 486
 - treatment of, 490
 - varieties of, 482

Cancer of alveolar processes, 868

- antrum, 871
- anas, 1040
- in axilla, 960, 964
- of bladder, 1137
 - bone, 720
 - breast, 948. *See* Breast
- in cheeks, 859
- chimney-sweeper's, 1200
- of eyeball, 851
- jaw, upper, 871
 - lower, 875
- of lachrymal gland, 851
 - lips, 868, 918
- of lymphatic glands, 562
- of muscles, 822
- in neck, 864
- of nose, 855, 858
- oesophagus, 890
- parotid gland, 862
- penis, 1156
- pharynx, 886
- prostate, 1151
- rectum, 1039
- scrotum, 1200
- skin, 557
- testis, 1219
- tongue, 889
- uterus, 1232
- Cancerous cachexy, 483
 - tubercle of tongue, diagnosis from syphilitic tubercle, 880
- Canceroid disease. *See* Cancer
- Carcinoma oss. 441
- Caution-shot, injuries by, 125
- Carcinoid's paste, 493
- Capillaries, enlarged after ligature, 177
 - state of, in inflammation, 59
- Capillary naevi, 682
- Caput obstipum, 843
- Carbonate of lime calculus, 1068
- Carbonic acid, asphyxia from, 388
- Carbuncle, 442
 - diagnosis of, 443
 - prognosis of, 443
 - signs of, 442
 - treatment of, 443
- Carcinoma reticulare, 486
- Carcinomatous stricture of oesophagus, 890
- Caries, 707
 - causes of, 707
 - operations for, 709
 - structure of, 707
 - symptoms of, 703
 - syphilitic, 544, 708
 - treatment of, 708
 - of trochanter, 513
 - of vertebrae, 788. *See* Spine
 - worm-eaten, 544
- Carotid Artery. *See* Artery, carotid
- Carpus. *See* Wrist
- Carron oil, 150
- Cartilages, diseases of, 742
 - destruction from synovial disease, 743
 - from disease of bone, 742
 - inflammation of, 743
 - of larynx, necrosis of, 902

- Cartilages (*continued*)
 loose, in joints, 753
 symptoms of, 753
 treatment of, 754
 of ribs, fractures of, 252
 ulceration of, 743
 Cartilaginous tumour, 480. *See* Enchondroma
 Castration, 1220
 Catarrh, vesical, 1133, 1138
 Catheter, female, 1227
 introduction of, 1170
 accidents attending, 1172
 prostatic, 1148
 shape and curve of, 1160
 Steele's, 1191
 Catheterism, forcible, 1182
 Cauliflower excrescence of rectum, 1039
 of uterus, 1232
 Caustics in abscess, 421
 in bites of rabid animals, 140
 bubo, 530
 cancer, 492, 956
 chomera, 520
 in dissection-wounds, 144
 epitheloma, 502
 nervus, 643
 piles, 1060
 stricture, 1173
 urethral tumours, 1192
 Cautery, galvanic, 423
 in uterine diseases, 1231
 chronic inflammation, 80
 hemorrhage, 164
 urethral tumours, 1192
 Cells, cancer, 483
 exudation, 83
 of lupus, 555
 pus, 87
 Cellular erysipelas, 450, 455
 exostosis, 726
 tissue, effusions into, 82
 Cellulitis, 450
 diffuse pelvic, 1098
 Collulo-cutaneous erysipelas, 448, 453
 Cephalo-aneurysm, 341
 subaponeurotic, 341
 supraparietal, 342
 Cerebral disturbance, 330. *See* Brain
 nerves, injuries of, 355
 Cervical region of spinal cord, effect of
 injury of, 306
 vertebra, dislocation of, 369, 370
 Chancre, 514
 adhesive, 515
 of anus, 518
 diagnosis of, 518
 in females, 518
 on fingers, 518
 gangrenous, 515
 Hunterian, 516, 534
 treatment of, 521, 526
 indurated, 516
 cicatrices of, 527
 on lips and tongue, 518
 mercury for, 521
 origin and progress of, 514
 Chancre (*continued*)
 phagedenic, 516
 simple, 515
 treatment of
 situation of, 517
 sloughing, 517
 treatment of
 soft, 515
 specific nature of
 suppuration, 517
 treatment of, 517
 urethral, 517
 varieties of, 515
 Chancroid, 516
 induration of
 cancer, 1192
 Cheek-compressor, 92
 Cheeks, diseases of
 fissures of, 248
 injuries of, 370
 nervi, of, 657
 tumours of, 459
 ulcers of, 459
 Cheiloplastic operation
 Cheilod, 152, 475, 506
 Chest, hemorrhage in
 injuries of, 306
 tapping the, 923
 Children, erysipelas in
 unstable bladders
 lateral lithotomy
 difficulties in
 median lithotomy
 syphilis in, 546
 tracheotomy in
 vaginal discharge
 Chimney-sweepers' cancer
 Chloroform, 9
 administration of
 cautions in using
 in catheterism, 1192
 dangers of, 12
 death from, 14
 effects of, 12
 in hernia, 981
 influence on morbid
 actions, 9
 inhalers for, 10
 Clever's, 11
 Snow's, 11
 in lithotomy, 1112
 in shock, 13
 treatment of effects of
 Cholelithiasis, 477
 Chopart's operation, 477
 Choroid, 1154
 treatment of, 1157
 Chronic abscess, 415, 416
 of breast, 941
 inflammation, 82
 mammary tumour,
 Cicatrix, 95, 150
 changes in, 96
 contraction of, 96,
 division of, 150

INDEX.

Cicatrices (continued).

- faulty, 114
- indurated syphilitic, 527
- sensibility of, 96
- structure of, 96
- warty tumours of, 152, 475, 553
- Circulation, collateral, after ligation, 176
- hemorrhage from, 178
- Circumcision, 1194
- Circumscribed traumatic aneurism, 187
- Circum dilatation of vessels, 680
- Cyale's operation of lithotomy, 1108
- urethrostomy, 1170
- Clavicle, dislocation of, 296
- excision of, 782
- fractures of, 252
- Cleft palate, 920
- operations for, on hard palate, 923
- on soft palate, 920
- Clergyman's sore throat, 895
- Climate, influence of, on aneurism, 580
- on calculus, 1072
- Clitoria, hypertrophy of, 1229
- removal of, 1229
- Cloacæ in necrosed bone, 711, 713
- Clove-bitch knot, 288
- Clover's chloroform inhaler, 11
- Cloth band, 836
- Club-foot, 844
- Congelation in piles, 1056
- Congonium of inflammatory blood, 61
- in wounded arteries, external, 160
- superficial, 175, 179
- internal, 160, 175
- Cobra di capello, bite of, 138
- Coccydynia, 268
- Coccyx, dislocation of, 314
- fracture of, 268
- Cod liver oil in scrofula, 511
- chronic inflammation, 79
- Cæcum in hernia, 968, 1007
- Cold abscess, 416
- Cold as an anæsthetic, 15
- effects of, 152
- treatment of, 153
- in hemorrhage, 164
- in inflammation, 70, 74, 79
- Collateral circulation, 176, 178
- Colligative discharges, 89
- Collodion, 113
- Colloid cancer, 482, 487
- of breast, 952
- Colon, hernia of, 1007
- obstruction in, seat of, 1025
- Colour of parts modified by inflammation, 62
- Columna nasi, restoration of, 907, 911
- Coina from chloroform, 14
- from compression, 332, 336, 357
- diagnosis of, 358
- treatment of, 338, 359
- Comminuted fracture See Fracture
- Complete ankylosis, 751
- dislocation, 286
- fistula, 1047
- Complicated dislocations, 298
- fractures, 217, 232, 236

- Compound dislocation, 285, 286
- fracture, 235 See
- Compress, graduated, 165
- Compression in aneurism, 607
- by finger, 613
- flexion, 612
- instruments, 607
- applicability of
- compared with
- 611
- history of, 607
- method of, 604
- principle of, 61
- of arteries in hemorrhage,
- brain, 332, 336
- from extravasation
- treatment of, 334
- in cancer, 494
- of breast, 955
- in chronic mammary tumour,
- popliteal aneurism, 674
- subclavian aneurism, 64
- Compressor, application of, 608
- Concretions, gouty, in ear, 865
- Concussion of brain, 330
- signs of, 331
- diagnosis of, 331
- treatment of, 337
- of spinal cord, 362
- treatment of, 364
- Condylomata, 475, 540
- diagnosis from piles, 1057
- in labia, 1227
- Congelation of cancer, 491
- Congenital dislocations, 285, 286
- fissures of cheeks, 918
- hernia, 1008
- of brain, 849
- inguinal, 1001, 1004
- hydrocele, 1204, 1222
- syphilis. See Syphilis
- Congestion, 55
- causes of, 56
- effects of, 56
- symptoms of, 55
- treatment of, 56
- Congestive abscess, 415
- inflammation, 68
- structure, 1165
- Conical stamps, 26
- Conjunctivitis, gonorrhæal
- Conservative surgery. See
- Constipation, duration of,
- obstruction, 1023
- Contagious diseases, 437
- infectious diseases, 437
- Continuity extension of
- by, 67
- Contiguity, extension of
- by, 67
- Continuous suture, 112
- Contractions of arm, 434
- of arteries from disease
- after wounds, 1
- of circulators, 26, 15
- in femoral canal,

- Contraction (continued).**
 of fingers, 836
 forearm, 835
 knee joint, 838. *See* Knee-
 muscles, 829
 neck, 833
 plantar fascia, 847
 of toes, 847
 wounded arteries, 160, 161
Contrecoup, fracture by, 215, 344
Contused wounds, 114
 amputation in, 118
 characters of, 114
 gangrene in, 115
 progress of, 115
 treatment of, 118
 varieties of, 114
Contusion, 105
 causes of, 105
 degrees of, 105
 diagnosis of, 106
 treatment of, 106
Contusion of abdomen, 309
 of arteries, 154
 bones, 209
 eye, 373
 joints, 210
 nerves, 207
 scalp, 341
 skull, 343
Cooper, Sir A., classification of dis-
 locations of h'j, 314
 of dislocations of shoulder, 209
Copula in gonorrhea, 1156
Cornoid process, fracture of, 256
Cornu, 551
Coronoid process, fractures of, 261
Corpuscular lymph, 83
Counter-irritants in chronic inflam-
 tion, 79
Counter opening in abscess, 420
Coxalgia. *See* Hip disease
Cranium. *See* Skull
Creeping bubo, 529
Crepitus in fracture, 219
Croup, spasmodic, 903
 tracheotomy in, 924
Croupous lymph, 83
Cubete in gonorrhea, 1156
Cuboid bone, dislocation of, 329
 excision of, 782
Cuneiform bone, dislocation of, 329
 excision of, 782
Cupping in inflammation, 74
Curdypus, 86
Curvature of spine, anterior, 787
 lateral, 823
Cutaneous erysipelas, 448
 syphilis, 533, 543
Cutting pliers, 20
Cut throat, 375
 treatment of, 377
Cyphosis, 825
Cystic bronchocele, 865
 cancer of breast, diagnosis of, 9
 strumecle, 1219
 sarcoma, 940

- Diet after operations, 17
before operations, 3
- Diffuse abscess, 416
aneurism, 583
arteritis, 570
inflammation, 68
mammary abscess, 941
pelvic cellulitis, 1098
phlebitis, 154, 564
traumatic aneurism, 186, 232
- Digital compression in aneurism, 613
- Dilatation of prostate in lithotomy, 1084,
1091, 1098, 1104
of urethra in stricture, 1167, 1169
- Diphtheria, tracheotomy in, 925
- Direct inguinal hernia, 1002
- Disarticulations. *See* Amputations
- Disease, mortality after amputations for,
29, 30
- Dislocation, 285
causes of, 285
complete, 285
complicated, 293
complicating fracture, 284
compound, 285, 292
congenital, 285, 294
effects of, 285
extension in, 289
with fracture, 293
incomplete, 285
mechanical contrivances for, 287
of old standing, 289
treatment of, 290
reduction of, 297
signs of, 286
spontaneous, 294
treatment of, 287
varieties of, 285
- Dislocations, Special, 295
of ankle, 325
backwards, 326
compound, 326
forwards, 326
inwards, 325
outwards, 325
astragalus, 326
backwards, 327
with bones of foot, 325
compound, 328
forwards, 327
atlas and axis, 369
carpal bones, 310, 312
clavicle, 296
outer end, 297
sternal end, 296
dysphagia frans, 888
coccyx, 314
cubital bone, 329
cuneiform bone, 329
elbow, 300
compound, 310
of old standing, 310
femur, 314. *See* Dislocations of
thigh bone
fibula, head of, 32
fingers, 313, 314
foot, 326, 329
- Dislocations, Special (continued).
forearm, bones of 306
backwards, 307
complications of, 309
compound, 310
forwards, 307
lateral, 307
of old standing, 310
in opposite directions, 308
reduction of, 309
of hand and wrist, 310
of hip, 314. *See* Dislocations of
thigh bone
humerus, 298
backwards, 300
causes of, 301
compound, 304
congenital, 304
diagnosis of, 302
downwards, 300
forwards, 300
inwards, 299
old unreduced, 304
partial, 301
reduction of, 302
signs of, 299
subclavicular, 300
subcoracoid, 299
subglenoid, 300
subscapular, 300
varieties of, 299
jaw, 295
bilateral, 295
congenital, 296
reduction of, 296
unilateral, 295
knee, 323. *See* Dislocations of
tibia
metacarpus, 312
metacarpophalangeal joints, 313
metatarsus, 320
os calcis, 329
os ilium, 312
patella, 322
inwards, 322
outwards, 322
upwards, 323
vertical, 322
pelvis, 314
pisiform bone, 312
radus, 307
backwards, 308
forwards, 307
outwards, 308
sacro-iliac articulation, 31
scapular bone, 329
scapula, 298
semilunar bone, 312
short bone, 313
symphysis pubis, 314
tarsal bones, 320, 329
thigh bone, 314
complicated with fracture
downwards, 310
forms of, 314, 316, 320
relative frequency of
in hip-disease, 300

Dislocations, Special (*continued*).
 ilio-sciatic, 319
 into obturator foramen, 319
 of old standing, 321
 on pubic bone, 319
 simultaneous, 322
 upwards, 319
 upwards and backwards, 316
 of thumb, 312, 313
 compound, 314
 tibia, 323, 340
 backwards, 323
 complicated, 324
 compound, 324
 forwards, 323
 lateral, 323
 ulna, 307
 vertebra, 369
 cervical, 369
 dorsal, 370
 wrist, 310
 backwards, 311
 compound, 311
 congenital, 312
 forwards, 311
 Dissecting aneurism, 583
 Dissection wounds, 143
 causes of phenomena in, 143
 symptoms of, 144
 treatment of, 144
 Diuretics in inflammation, 72
 Dogs, mad, bites of, 139
 Dorsal region of cord, injuries of, 365
 of spine, dislocations of, 370
 Double hernia, 1003
 Drainage-tubes, 421
 in empyema, 936
 Dressing of wounds, 16, 23, 111
 Dropsy of the uterus, 870
 of Esmarch tube, 1233
 ovarian, 1233
 Drowning, 384
 Drunkenness, diagnosis of traumatic
 coma from, 370
 Ducts, tumours from distension of, 470
 Duodenum, ulcer of, in burns, 147
 Dupuytren's lateral lithotomy, 1107
 classification of burns, 146
 splinters in gun-shot wounds,
 123
 enterotome, 996
 splint, 283
 Dura mater, fungus of, 848
 wounds of, 350
 Dysphagia from aneurism, 618, 621, 688
 causes of, 687
 Dyspnoea from aneurism, 617, 620
 EAR, bleeding from, 346
 congenious in, 852
 diseases of, 851
 fibrous tumours of, 852
 foreign bodies in, 371
 gouty concretions in, 852
 inflammation of, 851
 injuries of, 371

Ear (*continued*).
 polyp in,
 serous dis-
 Parache, 851
 Ear scoop, 371
 Ear-deafness, 12
 Ecchymosis, 16
 Erasour, 501,
 Ectropium, op
 Effusions, 81
 albumin
 of blood,
 causes of,
 of liquor
 secretion
 serum,
 varieties of
 Effusive infla
 Elbow, anchylo
 dislocation
 extension of
 fractures
 gun-shot
 wounds of
 Elephantiasis
 Embolism a c
 Emphysema of
 from woun
 treatment
 Emphysemato
 Empyema, 39
 drainage
 tapping t
 Encephalitis,
 acute, 33
 subacute,
 treatment
 Encephalocelo
 Encephaloid,
 structure
 of bone,
 breast,
 jaw, lo
 up
 nose,
 testis,
 tongue
 Encephalo-oste
 Enchondroma
 diagnosis
 locality of
 treatment
 of bone,
 jaw, lo
 up
 muscle
 Encysted abs
 calculus,
 herma of
 hydrocele
 tumours
 Enterocoele, 96
 Enteropneust
 Entero vagina
 Enterotome, 9
 Eutropium, op
 Epianthia, op

- Epithelioma**, 1201
Epithelioma, 968
Epithelioma, 992
Epithelioma, 1193
Epithelioma, 853
 treatment of, 853
Epithelioma, 482, 499
 causes in, 502
 characters of, 499
 diagnosis of, 501
 occurance in, 501
 excision of, 501
 ligature of, 501
 treatment of, 501
 of larynx, 903
 lips, 860
 nose, 855
 penis, 1196, 1197
 pharynx, 886
 tongue, 880
Epulis, 867, 871
 malignant, 868
 simple, 867
 treatment of, 867
Erectile tumours, 882. *See* **Nævus**
 diagnosis from aneurism, 589
Erratic erysipelas, 448
Eruptions, syphilitic, 538
 in children, 548
Erysipelas, 444
 blood in, 446
 a cause of death after operations, 7, 444
 of gangrene after ligature, 184
 secondary hemorrhage, 179
 causes of, 445
 cellular, 450
 treatment of, 455
 cellulitis cutaneous, 448
 treatment of, 453
 constitutional fever of, 445
 contagion of, 446
 cutaneous, 443
 treatment of, 452
 diagnosis of, 451
 from inflammation of absorbents, 559
 epidemic, 446
 erratic, 448
 external, 447
 varieties of, 448
 internal, 458
 after ligature, 179
 nature of, 444
 oedematous, 450
 phlegmonous, 446
 pregnancy of, 451
 simple, 458
 in stump, after amputation, 23
 treatment of, 452
Erysipelas of arachnoid, 460
 fauces, 458
 fingers, 456
 head, 455
 infants, 455
 larynx, 459
 mucous membranes, 458
Erysipelas (continued)
 of orbit, 455
 peritoneum, 460
 puella, 456
 scrotum, 456
 serous membranes, 460
Esmarch's method of applying cold, 90, 94
Ether as an anæsthetic, 15
Exanthematous, diagnosis from erysipelas, 451
 syphilitic, 538, 541
Excision of acetabulum, 810
 of ankle, 780, 783
 astragalus, 779
 bronchocele, 866
 cancer, 485
 clavicle, 762
 clitoris, 1229
 cuboid, 782
 cuneiform bone, 782
 elbow, 783
 results of, 766
 epithelioma, 501
 fibula, 773
 fingers, 769
 foot, bones of, 774
 great toe, 783
 hand, bones of, 768
 hip-joint, 779, 809
 joints, 756
 conditions of success in, 767
 in gun-shot wounds, 133, 762
 indications for, 759
 instruments for, 789
 operation of, 760
 repair after, 758
 knee, 770
 results of, 772
 lower jaw, 876
 metacarpal bones, 770
 metatarsal bones, 783
 navus, 684
 omentum in hernia, 992
 os calcis, 777
 parotid gland, 863
 pelvic bones, 810
 piles, 1059
 radius, 767
 scapular bone, 782
 scapula, 762
 shoulder-joint, 761
 for disease, 761
 gun-shot injury, 762
 tarsal bones, 774, 777
 tibia, 773
 toes, 783
 tumours, 503
 in urethra, 1192
 ulna, 767
 upper jaw, 874
 wrist, 768
Excoriation, chancreous, 515
Excreescences, syphilitic, 540
Excretory ducts dilated, 470
Exfoliation of bone, 712
Exhaustion a cause of death after operation, 6

- Exomphalos**, 1016
Exostosis, 726
 of upper jaw, 871
 varieties of, 726
 treatment of, 727
Extension of inflammation, 67
External inguinal hernia, 1001
 piles, 1050, 1063
 urethrotomy, 1177
Extravasation of blood, 105, 166
 in abdomen, 400, 404
 axilla, 305
 eye, 372
 fractures, 231, 232
 pleura, 391, 395
 skull, 357
 trephining for, 359
 of feces, 403, 405
 urine, 410, 1184
Extroversion of bladder, 1132
Extruded cells, 83
Eyelids, nose of, 687
 operations on, 908
 tumours of, 849
Eyes, cancer of, 851
 contusion of, 372
 extirpation of, 851
 gonorrhoeal inflammation of, 1159
 injuries of, 372
 syphilitic disease of, 543
 wounds of, 373
FACE, deformities of, 833
 fracture of bones of, 248
 gun-shot wounds of, 248
 injuries of, 370
 nose of, 687
 paralysis of, from aneurism, 639
 plastic surgery of, 604
 wounds of arteries of, 192
Facets of calculi, 1170
Faecal fistula, 964, 995
Faeces, extravasation of, 403, 405
Fallopian tube, dropsy of, diagnosis from
 ovarian dropsy, 1233
False aneurism, 582
 joints, 243
 causes of, 243
 treatment of, 246
 passages in urethra, 1172
Fascia, plantar, contraction of, 847
 propria, 1011
Fatty degeneration of arteries, 572, 579
 stumps, 27
 tumours, 476
 diagnosis from sebaceous tu-
 mours, 473
 treatment of, 477
 in crural canal, diagnosis from
 femoral hernia, 1013
 groin, diagnosis from abscess,
 790
 neck, 864
 of parotid gland, 862
 tongue, 843
Fauces, erysipelas of, 453
Female catheter, 1227
Females, diseases of, general
 congenital hernia
 diseases of general
 gonorrhoea in, 116
 irritability of, 116
 lithotomy in, 117
 lithotomy in, 117
 syphilis in, 518
Femoral artery, 862
 coarctation, 862, 867
 hernia, 1011
Femur, *See* Thigh-bone
Ferguson's operation, 921
Fever, hæmorrhagic, 116
 inflammatory, 116
 asthenic, 66, 70
 tired, acute
 irritative, 66, 70
 tired, acute
 asthenic, 66, 70
 tired, acute
 varieties in typhoid
 typhoid, diagnosis,
 464
Fibrine, increase of, in
 softened, diagnosis
Fibrinous lymph, 85
Fibro-cellular aneurism,
 tumours, 477
Fibro-cystic tumour of
 of lower jaw,
 muscle, 867
Fibroid tumour, tumour
Fibro-plastic tumour,
 of nose, 867
 pituitary, 1170
 retina, 1170
Fibrous stricture of
 of rectum, 1170
 tumour, 478
 in ligament, 478
 of breast, 343
 ear, 862
 neck, 864
 nose, 863
 diagnosis,
 867
 parotid gland
 upper jaw, 867
 uterus, 1232
Fibrovascular tumours
Fibula, luxation of, 867
 excision of, 773
 fracture of, 242
Figures of 8 sutures, 112
Fingers, amputation of,
 chancres of, 518
 congenital deformity
 conservative surgery
 contractions of, 867
 dislocation of, 343, 8
 enlargement of, 451
 erysipelas of, 451
 excision of, 760
 fractures of, 266

Fissure of anus, 1043
 cheeks, 918
 lip, 913. See *Hare-lip*
 nose, 855
 tongue, 879

Fistula, 422
 aërial, 378
 in ano, 1046
 operation on, 1043
 treatment of, 1047
 varieties of, 1046

antero-vaginal, 1041
 faecal, 924, 995
 lacrymal, 850
 in nasal bones, 912
 penile, 1188
 perineal, 1188
 rectal, 1041
 recto-vaginal, 1041
 recto-vesical, 1041
 salivary, 371, 869
 scrotal, 1188
 urethro-vaginal, 1189
 urinary, 1187, 1189
 vesico-vaginal, 1041, 1189

Flap-amputation, ordinary, 20
Todd's, 23

Flaps, formation of, in amputation, 20.
 See also *Amputations, special*
 rectangular, 24

Flat-foot, 547

Fleshy polypus, 856

Flexion in, aneurism, 612

Fœtal remains in mammary tumours, 948

Fœtus, syphilis of, 548

Fomentations, 75

Fontanelle, no-vus of, 686

Food, administration of, in cut-throat, 378

Foot, amputation of, 41
 arteries of, wounded, 200
 conservative surgery of, 774
 deformities of, 844
 disarticulations of, 41
 dislocations of, 325
 excision of bones of, 774
 fractures of, 284
 ganglionic tumours of, 821
 gun-shot wounds of, 132

Forceps, artery, 172
 bullet, 120
 cutting, 716
 lithotomy, 1078
 removal of polyp by, 857
 for removing small bodies, 187

Forceful catheterism, 1182
 expansion of stricture, 1174

Forearm, amputation of, 37
 arteries of, wounded, 197
 deformities of, 835
 dislocations of, 306
 extension of bones of, 767
 fractures of, 261

Forehead, injuries of, 370

Foreign bodies in air-passages, 379
 in bladder, 409
 brain, 354
 chest, 393, 395

Foreign bodies (continued).
 in ears, 371
 food passages, 389
 dysphagia from, 888
 gun-shot wounds, 128
 hernial sac, 967
 incised wounds, 111
 nostrils, 371
 rectum, 411
 skull, 355
 urinary organs, 409
 vagina, 411

Fractures, 214
 accidents in, treatment of, 280
 amputations in, 233, 234, 235, 241
 arteries wounded in, 232, 236
 badly set, treatment of, 242
 bandages in, 226
 causes of, 214
 comminuted, 216
 completing dislocation, 293
 complications of, 217, 232, 236
 compound, 235
 amputation in, 235, 241
 complications of, 236
 dangers of, 235
 reduction of, 239
 treatment of, 235, 233
 union of, 223
 by contrecoup, 215
 crepitus in, 219
 delayed union in, 242
 diagnosis of, 220
 displacement in, 218
 directions of, 219
 false joints after, 243
 removal of, 247
 treatment of, 246

gangrene in, 226, 231
 in pætel, 216
 in amplex, 217
 intraperiosteal, 217
 longitudinal, 217
 mobility, preternatural, in, 219
 from muscular action, 215
 oblique, 217
 plaster of Paris bandage in, 230
 reduction of, 224
 resetting of, 243
 signs of, 218
 simple, 216
 amputation in, 233, 234
 complications of, 232
 treatment of, 224
 union of, 222

special apparatus in, 227
 splints in, 216
 spontaneous, 216
 starched bandage in, 237
 transverse, 217
 treatment of, 221
 accidents during, 230
 ununited, 243
 causes of, 243
 treatment of, 245
 union of, 221
 varieties of, 216

Fractures, Special, 248
 of acetabulum, 267
 avulsion, 255
 at ankle-joint, 282
 compound, 283
 of arm, 259
 calcaneum, 284
 cartilages of ribs, 252
 clavicle, 252
 comminuted, 254
 coccyx, 268
 coronoid process, 256
 coronoid process, 261
 at elbow-joint, 259, 261
 compound, 260
 excision for, 260, 310, 763
 of facial bones, 248
 femur, 268. See Fractures of thigh-bone
 fibula, 282
 fingers, 266
 foot, 284
 forearm, 261
 compound, 262
 humerus, 256
 in attempt to reduce old dislocation, 305
 condyles of, 260
 head of, compound, 259
 excision for, 762
 lower end of, 259
 neck of, compound, 258
 extracapsular, 267
 intracapsular, 266
 shaft of, 259
 tubercle of, 258
 hyoid bone, 250
 at knee-joint, 277
 of lachrymal bone, 248
 larynx, 375
 leg, 280
 lower extremity, 266
 lower jaw, 249
 malar bone, 248
 metacarpus, 266
 nasal bones, 248
 olecranon, 261
 patella, 277
 pelvis, 266
 injuries of viscera in, 409
 Pott's, 282
 of radius, 263
 ribs, 250
 sacrum, 267
 scapula, 255
 acromion process of, 255
 coronoid process of, 256
 neck of, 256
 of septum of nose, 248
 near shoulder-joint, 255
 of skull, 344. See Skull
 spine, 367
 sternum, 252
 thigh bone, 268
 in attempts to reduce old dislocation, 321
 lower end of, 277

Fractures, Special (continued)
 of thigh bone (continued), extracapsular, 272
 intracapsular, 258
 diagnosis of, 258
 arthritis, 245
 shaft of, 275
 compound and comminuted, 275, 276
 through trochanter, 27
 tibia, 256
 compound, 280
 ulna, 261
 coronoid process of, 256
 olecranon process of, 259
 upper extremity, 259
 upper jaw, 245
 vertebra, 367
 at wrist, 262
 of zygoma, 248
 Fragilitas ossium, 721
 Friction in chronic inflammation, 78
 Frontal sinuses, absorption of, 328
 polyptosis, 328
 Frost-bite, 123
 Function modified by dislocation, 305
 Fungous warts of penis, 364
 thecoma from, 1177
 Fungous growth in bladder, 37
 Fungus cerebri, 356
 of dura mater, 343
 hematomas, 326
 of skull, 343
 Fusiform aneurism, 581
 GALVANIC cautery, 427
 Galvano-puncture in aneurism, 581
 Ganglion, 820
 diagnosis from aneurism, 580
 in foot, 821
 hand, 821
 Gangrene, 97, 428
 acute, 97
 amputation in, 118, 145, 146
 arrest of, 98
 from arterial obstruction, 100
 431, 570, 571
 causes of, 97, 428
 contagious, 437
 incised and lacerated, 427
 diagnosis of, 427
 from embolism, 430
 from extravasated blood, 428
 in fractures, 220, 231
 from frost-bite, 133
 hospital, 437. See Gangrene
 gendena
 incisions in, 99
 inflammatory, 97
 treatment of, 98
 of intestine in hernia, 577
 management of, 577
 after ligature, 183, 429, 430
 664, 675
 causes of, 184
 character of, 185
 treatment of, 185, 554

Gangrene (continued).

- line of demarcation in, 98, 427
 - line of separation in, 98
 - local signs of, 427
 - moist, 97
 - after operations, 6
 - from pressure of aneurism, 585, 588, 605
 - prognosis of, 428
 - palpy, 437
 - senile, 431
 - amputation in, 436
 - treatment of, 433
 - separation of sloughs in, 98
 - from snake-bites, 138
 - special forms of, 436
 - spontaneous, 430, 571
 - from strangulation, 429
 - symptoms of, 97, 427
 - traumatic, 115, 428
 - causes of, 116
 - modes of occurrence of, 115
 - spreading, 116
 - symptoms of, 117
 - treatment of, 120
 - treatment of, 98, 120, 432
 - varieties of, 426
 - from venous obstruction, 431
- Gangrenous diseases, 436**
- inflammation, 97
 - treatment of, 98
 - phagedena, 517
 - stomatitis, 441

Gases, noxious, asphyxia from, 388

Gastrostomy, 891

Gastrostomy, 1027

Gelatinous cancer, 482, 487

- polypus, 856

Genital organs, female, disease of, 1226

- wounds of, 409

Geno vulgum, 837

Gland, lacrymal. See Lacrymal Gland

- mammary. See Breast
- parotid. See Parotid
- thyroid. See Thyroid Gland

Glands, changes in secretion of, from inflammation, 82

- hypertrophy of, 476
- lymphatic. See Lymphatic Glands
- tumours connected with. See Tumours
- diagnosis from aneurism, 572

Glands penis. See Penis

- herpes of, 1196

Gleet, 1154

treatment of, 1157

Globular piles, 1054

Glossitis, 878

Glossitis, oedema of, 894

- scabs of, 334

Gluteal artery. See Artery, Gluteal

Gonorrhoea, 1153

- cause of, 453
- complications of, 1157
- in females, 1161
- hemorrhage in, 1158
- injections in, 1156
- irritable bladder in, 1157

Gonorrhoea (continued)

- retention of urine in, 1158
 - sequences of, 1158
 - stages of, 1154
 - treatment of, 1155
- Gonorrhoeal conjunctivitis, 1159**
- cutaneous eruptions, 1161
 - induration of penis, 1159
 - inflammation of nose, 1161
 - orchitis, 1159
 - rheumatism, 1161
 - scleritis, 1160
 - stricture, 1159
 - warts, 1159

Gouge forceps, 709, 716

Gouges, 709

Gout, irritable bladder in, 1135

Gouty concretions in ear, 852

Granular degeneration of arteries, 572

- Granulations, 94, 102
 - incisions afforded by, 94
 - sensibility of, 94
 - structure of, 94
 - union of missed wounds by, 110
 - vascularisation of, 94

Grave-shot, injuries from, 123

Gravel, 1004

Gravitation, influence of in congestion, 56

Green-stick fracture, 217

Groin, abscess in, causes of, 789

diagnosis of. See Abscess

aneurism in, 663

tumours in. diagnosis of, 1032

Gross, Dr., statistics of foreign bodies in air-passages, 381

Growth. See Tumours

vascular. See Nevus

Gums, diseases of, 867

Gunpowder, injuries from, 122

Gun-shot wounds, 122

- amputation in, 131
- period of, 134

apertures of, 124

arteries injured in, 126, 128

of bones of limbs, 131

characters of, 122

consequences of, 130

excursions in, 133, 762

hemorrhage from, 126

arrest of, 127

secondary, 140

immediate attention to, 137

inflammation in, 126

of joints, 132

local applications to, 130

pain in, 125

peculiarities of, 122

removal of foreign bodies, 123

shock in, 128

symptoms of, 125

treatment of, 127

of ankle-joint, 133

elbow-joint, 134

face, 243

foot, 132

hand, 132

hip-joint, 133

Gun-shot wounds (continued).

- of knee, 133
 - leg, 132
- lower jaw, 250
- mouth, 374
- palate, 374
- pharynx, 374
- shoulder joint, 134
- thigh, 131, 133

Gutta-percha splints, 249

Hair, syphilitic affections of, 539

- tumours containing, 474

Hamstring tendons, contractions of, 842

- division of, 843

Hani, amputations of, 33

- aneurism of, 661
- arteries of, wounded, 197
- deformities of, 834
- from contraction of muscles of arm, 835
- dislocations of, 310
- extension of bones of, 763
- fractures of, 266
- ganglions of, 820, 821
- gangrene of after ligation of subclavian, 653
- gun-shot wounds of, 132

Hanging, asphyxia from, 363

Hard cancer, 482. See Scurthau

Hare-lip, 913

- age for operation in, 914
- double, 913
- single, 913
- operation for, 914
 - double, 916
 - single, 915
- by suture alone, 917

Head, diseases of, 848

- erysipelas of, 455
- injuries of, 330

Healing process. See Cicatrisation and Granulation

Health, general, influence on result of

- amputations, 23
- on result of operations, 2
- on tendency to suppuration, 89
- on traumatic gangrene, 116

Healthy ulcer, 423

Hearing, how affected by intracranial aneurism, 639

Heart, action of, diminished by hemorrhage, 159

- influence of, on production of aneurism, 579

- examination of, before operation, 3
- rupture of, 399
- wounds of, 397

Heat, effects of, 135

- gangrene from abstraction of, 185
- from incautious use of, 185
- increase of, in inflammation, 63

Hectic, 89

- treatment of, 91

Hematocoele, 1211

Hematocoele (continued).

- diagnosis of, 1213
- from hernia, 1209
- of spermatic cord, 1212
- treatment of, 1212

Hematoma, 120, 474

Hematuria, 1138

Hemiplegia from cerebral

Hemorrhage, 372

Hemorrhage, 156

- in amputation, how

- arrest of, 153

arterial, 156. See Hemorrhage

from bladder, 1134

into chest, 391, 395

in compound fracture

constitutional effects of

distinctive characters

in fracture of base of

gangrene, 99

from gun-shot wound

increased wounds, 2

kidneys, 1135

in lithotomy, 1093, 1094

nasal, 853

natural arrest of, 158

after operations, 6

permanent arrest of,

from piles, 1054

prevention of, in amputation

from prostate, 1135

secondary, in gunshot

after ligation, 173

of external iliac

subclavian, 653

superficial, 156

causes of, 178

phenomena of,

treatment of, 16

after lithotomy, 1094

from stump, 23

temporary arrest of,

surgical, 163

in tracheotomy, 923

transfusion of, 157

treatment of, 157, 163

by noncompressive,

cauterisation, 163

cold, 164

ligature, 163

pressure, 163, 164

styptic, 164

tension, 163

from urethra, 1133, 1134

venous, 154, 156

arrest of, 154

in wound of throat, 23

Hemorrhage, diathesis, 601

fever, 157

ulcers, 426

Hemorrhoids, 1050. See Hemorrhoids

Hemorrhoids, 391, 395

Hernia, 965

cervical, 963

containing bladder, 966

INDEX.

Hernia (continued).

- causes of, 968
- contents of, 966, 968
- conditions presented by, 969
- definition of, 965
- double, 980
- incarcerated, 975
- internal, 1024
- intestinal, 968
- irreducible, 974
 - diagnosis of, 1323
 - from strangulated hernia, 978, 980
 - inflamed, 975
- omental, 966, 968
- operation with opening sac, 984
 - accidents attending, 986
 - after-treatment of, 987
 - artificial anus after, 994
 - division of stricture in, 986
 - exposure of sac in, 984
 - fecal fistula after, 994, 995
 - management of adhesions, 991
 - of congested and constricted intestine, 989
 - gangrenous intestine, 990
 - omental cysts, 993
 - sacs, 992
 - omentum, 992
 - opening sac in, 984
 - peritonitis after, 988
 - sloughing of sac after, 994
 - wounds of arteries in, 993
 - of intestine, 993
- operation without opening sac, 997
 - history of, 997
 - objections to, 997
 - performance of, 999
 - statistics of, 998
- radical cure of, 970
 - Wood's operation, 972
 - Wutzer's operation, 971
- reducible, 969
- sac of, 966
 - adhesions of, 967, 991
 - contents of, 966
 - foreign bodies in, 967
 - hydrocele of, 967, 1001
 - signs of, 968
- strangulated, 973
 - diagnosis of, 979
 - effects of, on intestine, 977
 - mechanism of, 979
 - operation for, 984 *See above*
 - peritonitis in, 979
 - reduction of, 980, 987
 - in mass, 999
 - symptoms of, 1000
 - treatment of, 1000
 - persistence of symptoms after, 980
 - seat of stricture in, 976
 - symptoms of, 978
 - modifications of, 979
 - taxis in, 980
- structure of, 965
- truss for, 970

Hernia, Special Forms of, 1001

- of bladder, 968, 1007
 - bruin, 356
 - congenital, 849
 - caecal, 968, 1007
 - of colon, 1007
 - diaphragmatic, 402, 1020
 - femoral, 1011
 - contents of, 1012
 - course of, 1011
 - diagnosis of, 1013
 - from abscess in groin, 71
 - fascia propria of, 1011
 - opening sac in, 1015
 - operation for, 1014
 - symptoms of, 1012
 - treatment of, 1014
 - inguinal, 1001
 - complete, 1001
 - congenital, 1001, 1003
 - in females, 1010
 - diagnosis of, 1004, 1222
 - direct, 1001, 1002
 - coverings of, 1002
 - relations of, 1003
 - double, 1003
 - encysted, 1001, 1010
 - external, 1001
 - fascia propria of, 1003
 - incomplete, 1001, 1003
 - operation for, 1007
 - infantile, 1001, 1010
 - interstitial, 1001, 1003
 - large intestine in, 1007
 - oblique, 1001
 - coverings of, 1001
 - relations of, 1002
 - operation for, 1006
 - seat of stricture in, 1007
 - symptoms of, 1004
 - treatment of, 1006
 - urinary bladder in, 1007
 - varieties of, 1001
 - of lungs, 396
 - obturator, 1019
 - omental, 968
 - perineal, 1019
 - puddendal, 1020
 - sciatic, 1020
 - scrotal, 1001
 - of tunica vaginalis, 1001, 1003
 - diagnosis of, 1009
 - encysted, 1010
 - treatment of, 1010
 - umbilical, 1016
 - operation for, 1017
 - treatment of, 1017
 - vaginal, 1019
 - ventral, 1018
- Herpes of xians and prepuce, 1100
- diagnosis from chancre, 518
- Hey's amputation of the foot, 42
- High operation of lithotomy, 1103, 1104
- Hilton, Mr., his method of opening abscesses, 420
- Hip, amputation at, 52
- results of, 55

Hip (*continued*).
 dislocations of, 314. *See* Dislocations
 of thigh bone
 excision of, 776, 800
 gun-shot wound of, 133
 neuralgia of, 755
 diagnosis from sacro-iliac disease,
 795
 rheumatic arthritis of, 746. *See*
 Arthritis
Hip-disease, acetabular, 802
 excision in, 810
 ankylosis in, 800
 arthritic, 801
 excision in, 808
 treatment of, 806
 attitude in, 798
 diagnosis of, 806
 from caries of spine, 790
 from sacro-iliac disease, 796
 dislocation in, 800
 femoral, 812
 excision in, 800
 treatment of, 807
 forms of, 798
 junction, 798
 pathological conditions in, 798
 prognosis of, 804
 sinuses in, 799
 suppuration in, 799. *See* Abscess
 treatment of, 806.
Holt's treatment of structure, 1175
Horns, 471
Hospital gangrene, 437. *See* Sloughing
Phagedæna
Housemaid's knee, 815, 816
 true, 818
Humers, amputation of, 35
 disarticulation of, for aneurism, 660
 dislocations of, 293
 fractures of, 256
 tumours of head of, diagnosis from
 aneurism, 651
Hunterian chancre, 516. *See* Chancre
 operation for ligature, 698
Hydatids in bone, 723
 breast, 948
 muscles, 823
Hydrarthrosis, 736
 treatment of, 738
Hydrocele, 1204
 acute, 1202
 congenital, 1204
 diagnosis of, 1222
 encysted, 1210
 diagnosis from hernia, 1004
 treatment of, 1210
 of hernial sac, 967, 1001
 neck, 864
 spermatic cord, 1211
 diagnosis from hernia, 1004
 diffused, 1211
 diagnosis of, 1222
 of tunica vaginalis, 1204
 diagnosis of, 1223
 from cystic sarcocele, 1219
 from hernia, 1005

Hydrocele (*continued*).
 hydrocele, 1204
 serous, 1204
 symptoms of, 1204
 treatment of, 1204
Hydrophobia, 120
 causes of, 120
 pathology of, 141
 prognosis of, 141
 symptoms of, 140
 treatment of, 141
Hydrops pericardii, 120
 985
Hydrostrabismus, 1216
 syphilitic, 545
Hydrothorax, tapping of
Hygienic influences on pro-
sperity, 443
 of pyæmia, 46
 on result of am-
 putation, 46
Hymen, imperforate, 122
Hyoid bone, fracture of
Hyperæmia, local, 56
Hypertrophy of bone, 72
 breast, 537
 clitoris, 1229
 glandular structure
 lateral, 1227
 lips, 859
 prostate, 1196
 thyroid gland, 3
 tongue, 533
 tonsils, 585
Hypochondriac region, he-
 miphyspachia, 1193
Hysterical disease of joints
 of knee, 839
 stricture of urethra,
 839
Ice, application of in case
 in inflammation, 76
 as an anæsthetic, 15
Ichorous pus, 46
Iliac abscess, diagnosis of
 artery. *See* Artery
 in lesion in superficial
 ilio-sciatic dislocation, 310
Iliac sciatic dislocation, 310
Impacted fracture. *See* Fracture
Imperforate anus, 1034
 hymen, 1228
 vagina, 1228
Impermeable structure, 112
Impetigo, 1223, 1225
Incarcerated hernia, 975
Incised wounds, 108
 treatment of, 111
 union of, 108
Incision of abscesses, 119
 in inflammation, 73
 operations, 15
Incomplete umbilical hernia, 75
 dislocation, 255
 fistula, 1047
 fracture, 217
 hernia, 1003

Incontinence of urine, 1141
 Incrustation, healing by, 109
 Indurated chancre, 516
 cicatrices, 527
 Induration, 67
 Infantile hernia, 1001, 1010
 syphilis, 546
 Infants, overlying of, 338
 tetanus in, 697. *See* Children
 Inflamed ulcer, 425
 Inflammation, 58
 blood changed in, 58, 60
 blood vessels in, 59
 causes of, 68
 characters of, 68
 coagulation of blood in, 61
 constitutional symptoms of, 64
 development of lymph modified by, 85
 diagnosis from neuralgia, 604
 duration of, 68
 effects of, 67
 extension of, 67
 fever in, 64
 function disturbed by, 64
 heat in, 63
 induration after, 67
 intensity of, 68
 local signs of, 62
 metastasis of, 67
 nomenclature of, 65, 68
 opacity of parts from, 68
 pain in, 63
 phenomena of, 58
 pyrexia in, 64
 redness in, 62
 resolution of, 66
 secondary forms of, 61
 softening after, 67
 swelling in, 62
 symptoms of, 62, 64
 terminations of, 66
 treatment of, 69
 ulceration after, 67, 68
 varieties of, 68
 wasting of parts after, 68
 Inflammation, acute asthenic, 66
 antiphlogistics contraindicated in, 75
 stimulants and tonics in, 76
 treatment of, 75
 acute sthenic, 65
 blood-letting in, 71
 local, 73
 cold in, 74
 cupping in, 74
 diaphoretics in, 72
 diuretics in, 72
 leeches in, 73
 mercury in, 72
 opium in, 72
 position of part in, 75
 punctures in, 73
 purgatives in, 71
 warmth in, 74
 adhesive, 83, 110. *See* Lymph
 union by, 110

Inflammation (*continued*).

chronic, 69
 astringents in, 80
 blisters in, 80
 blood-letting, local, in, 79
 cantharids in, 80
 cod liver oil in, 79
 counter-irritation in, 79
 diet in, 78
 frictions in, 79
 iodide of potassium in, 78
 issues in, 80
 mercury in, 78
 pressure in, 81
 purgatives in, 79
 sarsaparilla in, 79
 setons in, 80
 treatment of, constitutional, 77
 local, 79
 warmth in, 79
 diffuse, 68
 effusive, 81
 erysipelatous. *See* Erysipelas
 gangrenous, 97. *See* Gangrene
 gonorrhoeal. *See* Gonorrhoea
 irritative, 69
 low diffused, 450
 a cause of erysipelas, 447
 gangrene after ligature in, 179
 after operations, 6, 7
 strumous, 606. *See* Scrofula
 suppurative, 86. *See* Pus and Sup-
 puration
 causes influencing, 89
 diet in, 89
 products of, 86
 symptoms of, 89
 treatment of, 90
 syphilitic. *See* Syphilis
 ulcerative, nature of, 91. *See* Ulcer
 and Ulceration
 treatment of, 96
 Inflammation of anovisceral sac, 592
 after ligature, 603
 areola, 939
 arteries, 569
 bladder, 1132
 after lithotomy, 1093
 after lithotomy, 1118
 of bone, 703
 brain, traumatic, 333, 338
 breast, 758
 in burns, 147
 of bursa patellæ, 516
 cartilage, 743
 ear, 551
 epistaxis, 1201
 in gunshot wounds,
 of hernial sac, 978, 9
 hip, 748
 intestine in hernia
 irreducible hernia
 of joints, 749
 traumatic, 2
 knee, contracture
 larynx, 892
 lungs, after ligature

Inflammation (*continued*).of lungs, after ligation of subclavian,
655lymphatic glands, 560
vessels, 559

mammary gland, 940

muscles, 821

nerves, 692

nipple, 939

parotid gland, 861

pelvis, diffuse, 1098

periosteum, 703

peritoneum, 407, 979, 980, 985, 1100

pharynx, 886

prostate, 1142

sheaths of tendons, 821

synovial membranes, 736

testes, 1201

ul descending, 1009, 1203

tongue, 873

tonsils, 885

urethra, 1152

uterus, chronic, 1230

veins, 562

Inflation of intestines, 1027

Inguinal aneurism, 463
hernia, 1461. *See* Hernia

Inhalers, chloroform, 10

Injections in gonorrhoea, 1156

in hydrocele, 1207

subcutaneous, in neuralgia, 694

Injury, amputation for, 29

effects of, 165

Innominate artery. *See* Artery, Inno-
minate

Insects, stings of, 137

Instruments, amputating, 20

Eithotomy, 1078

lithotomy, 1110

Intercostal artery. *See* Artery and
Aneurism

Intermaxillary bones in hare-lip, 918

Internal organs, states of contraindicat-
ing operation, 3

piles, 1053

urethrotomy, 1175

Interrupted suture, 112

Interstitial hernia, 1003

Intestinal obstruction, 1021

acute, 1021

causes of, 1021

symptoms of, 1022

treatment of, 1026

Amussat's operation for, 1029

chronic, 1022

causes of, 1022

symptoms of, 1023

treatment of, 1028

diagnosis of, 1023

duration of constipation in, 1023

gastrostomy in, 1027

inflation in, 1027

seat of, 1025

vomiting in, 1024

Intestine, adhesions of, in hernia, 991

congested, in hernia, 1177

management of, 989

Intestine (*continued*).constricted, in
cf, 989

flatulous opening

gangrenous, in

management

hemorrhage of

piles, 105

large, diseases

Piles, in

hernia of, 985

inflammation of

malformation of

wounds of, 39

in operation

treatment

Intracranial aneurism

extravasation of

suppuration, 3

Intraorbital aneurism

Intrathoracic aneurism

tumours, dysplasia

Intussusception, 10

Inversion of body,

in air-tubes

Iodide of potassium

mation, 78

Iodine, injection of

in joint of

in ovarian

in scrofula, 51

Iritis, syphilitic, 51

Iron, perchloride of

in scrofula, 51

Irreducible hernia

Irrigation, mode of

Irritable bladder

ulcer, 425

Irritation, cerebral

treatment

chronic, 57

from foreign body

380

Irritative fever, 61

traumatic, 61

Ischio-rectal abscess

Isinglass plaster, 12

Issues, 80

Ivory exostosis, 72

JARVIS'S adjuster, 2

Jaw, lower, diseases

dislocation

excision of

fractures of

gun-shot

necrosis of

rheumatic

subluxation

tumours of

upper, diseases

excision of

fracture of

necrosis of

tumours of

Jaws, diseases of, 86

Joints, amputation of. See Amputation and the various joints
 in disease, 783
 ankylosis of, 751. See Ankylosis
 cartilaginous of, 744
 changes in cartilage of, 742
 chronic rheumatic disease of, 746.
 See Arthritis
 contusion of, 210
 diseases of, 735
 excision of, 756. See Excision
 false, 243
 fluid collections in, 736, 737
 fractures extending into, 233, 236
 gun-shot wounds of, 132
 hysterical affections of, 755
 incisions into, 745
 inflammation of, 211, 739. See Arthritis
 of synovial membranes of, 736.
 See Synovitis
 injuries of, 210
 loose cartilages in, 753
 neuralgia of, 755
 sprains of, 210
 strumous disease of, 507
 suppuration in, 213, 740, 745
 traumatic inflammation of, 211
 complicating compound fracture, 236
 symptoms of, 211
 treatment of, 212
 wounds of, 211, 233, 236

KIDNEYS, calculi in, 1069
 disease of, induced by calculus, 1077
 from stricture, 1167
 influence of on operations, 3
 on lithotomy, 1097
 lithstriv, 1124
 pain in bladder from, 1135
 hemorrhage from, 1138
 irritation of from lithstriv, 1119
 rupture of pelvis of, 400

Knee-joint, amputation at, 49
 ankylosis of, 840, 843
 contraction of, 838
 chronic, 840
 from contracted tendons, 842
 extension in, 841
 hysterical, 839
 from inflammation, 839
 with lateral displacement, 843
 from ligamentous consolidation, 842
 treatment of, 839, 841, 843
 deformities of, 837
 disease of, diagnosis from hip-disease, 806
 dislocations of, 323
 excision of, 770
 result of, 772
 fractures near, 277
 gun-shot wounds of, 133
 subluxation of, 324
 wounds of, 213

Knives, amputating, 20
 hernia, 980
 lithotomy, 1079
 method of holding, 1088
 Knock-knee, 837
 Knot, clove-litch, 288
 reef, 172

LAMA, condylomata of, 1227
 cystic tumours of, 1228
 hypertrophy of, 1227
 nevus of, 889, 1227

Lacerated wounds, 114

Laceration of arteries, 154

of perineum, 411

urethra, 410

veins, 154

Lacrimal bone, fracture of, 248

gland, extirpation of, 551

sac, puncture of, 849

Lactal secretion, abnormal, 937

tumour, 938

Laminar deposit in arteries, 574

Laryngeal lithiasis, 896, 902

Laryngitis, 892

acute, 893

chronic, 895

results of, 902

erysipelatous, 459

oedematous, 894

Laryngoscope, 896, 903

Laryngotomy, 923, 926

compared with tracheotomy, 931

indications for performance of, 932

for removal of foreign bodies, 332

Laryngo-tracheotomy, 926

Larynx, abscesses near, 902

chronic irritation of, 895

conditions of, producing dysphagia,

887

diseases of, 892

dislocation of, 375

epithelioma of, 903

erysipelas of, 459

fracture of, 375

inflammation of. See Laryngitis

necrosis of, 902

nervous affection of, 903

oedema of, 894

plastic deposits in, 902

syphilitic disease of, 541, 542

topical medication of, 896

tumours in, 903

ulceration of, 902

wounds of, 375, 376

Lateral curvature of spine, 823. See

Spine

displacement of tibia, 840

Lithiatic deposits in urine, 1065

Leeches in inflammation, 73

Leg, amputation of, 47

arteries of, wounded, 200

characer on, 518

excision of bones of, 773

fracture of, 250

gun-shot wounds of, 132

Lencorrhœa, 1280
Ligaments of joints, disease in, 739
 of knee, consolidation of, 840
Ligature of arteries, 165, 595
 accidents after, 178, 600
 in amputations, 22
 appl. tion of, 171
 effects of, 174
 gangrene after, 183, 429
 history of, 163
 materials for, 172, 174
 principles of application of, 169
 re establishment of circulation after, 178
 secondary hemorrhage after, 178
 in aneurism, 595
 above and below sac, 596
 accidents after, 600
 Anel's, 596
 Brasdor's, 598
 on carinae vici, 596
 compared with compression, 611
 conditions influencing success
 of, 598
 on distal side, 598
 effects of, 597
 gangrene after, 605, 658, 664,
 675
 history of, 596
 Hunter's, 596
 indications and contraindica-
 tions of, 598
 recurrent pulsation after, 600,
 602
 secondary aneurism after, 602,
 678
 suppuration of sac after, 603
Ligature of aneurism by anastomosis, 631
 in cancer of tongue, 581
 epithelioma, 501
 of nevus, 654
 piles, 1059
 polypos of nose, 857
 of rectum, 1041
 prolapsus ani, 1063
 thyroid arteries in bronchocele, 866
 tumours of urethra, 1192
Limbs, artificial, 26
 navion, 590
Lime, carbonate of, in urine, 1068
 phosphate of, in calcoli, 1067
Limiting membrane of abscess, 88
Linea alba, hernia through, 1018
Lip, cancer of, 860
 removal of, 860, 918
 congenital malformations of, 859.
 diseases of, 859
 epithelioma of, 860
 fissures of, 859
 hypertrophy of, 859
 nevus of, 688, 860
 plastic surgery of, 913. *See* Haro-
 lip
 restoration of, 918
 syphilitic disease of, 518, 541
 tumours of, 860
 ulceration of, 859

Lip (continued)

wound of, 370
Lipoma, 477, 855
 neural, 690
Liquor melanous, 4
Liquor pancreaticus, 80
 sanguineus, effusion
 in inflammation
Liston's method of *see*
 of holding kn
 1093
Lithectasy, 1129
Lithic acid calculi, 106
 diathesis, 106
Lithotome caché, 1107
Lithotomy, 1078
 accidents during, 1
 after-treatment of, 1
 Allaiton's operation
 bilateral, 1147
 combined with
 bruising and over-
 causes of death after
 in children, 1088
 difficulties in, 1
 choice of operation, 1
 Civiale's operation, 1
 cystitis after, 1088
 dangers attending, 1
 difficulties in, 1084
 extraction of stone in
 difficulties of, 10
 fracture of os pubis in
 hemorrhage after, 10
 during, 1093
 venous, 1094
 influence of age on, 1
 of state of bladder
 instruments for, 1078
 lateral, 1080
 median, 1100
 in children, 110
 compared with li
 history of, 1100
 indications for, 1
 for prostate, 110
 missing vessels in, 1
 pelvic cellulitis after,
 peritonitis after, 1100
 position of hand in, 1
 prostatic, for, 1072
 prolonged, danger of,
 prostate, of lithotomy,
 1088, 1094
 recurrence of calculi
 removal of large and
 sloughing after, 1100
 statistical, 1090
 suprapubic, 1108
 in women, 1130
 urethral, 1127
 vaginal, 1130
 in women, 1130
 wound of arteries in,
 of bladder, 1095
 bulb, 1095, 110
 rectum, 1095, 110

Lithotrite, 1110
 Cliviale's, 1111
 introduction of, 1112
urethral, 1117
 Weiss's, 1110

Lithotomy, 1110
 accidents in, 1117
 anæsthetics in, 1112
 atony of bladder after, 1119
 complicating, 1125
 breaking stone in, 1114
 compared with lithotomy, 1120
 conditions influencing propriety of, 1122
 of Halder, 1125
 kidneys, 1124
 prostate, 1125
 urethra, 1125
 constitutional disturbance from, 1119
 cystitis after, 1118
 dangers in, 1118
 in females, 1131
 impaction of fragments of stone in urethra, 1117
 instruments for, 1111
 introduction of lithotrite in, 1112
 operation of, 1112
 preparation of patient for, 1111
 recurrence of calculus after, 1126
 seizure of stone in, 1113
 statistics of, 1120

Littre's operation, 1028

Liver, ruptures of, 400

Longitudinal fracture. *See* **Fracture**
 ribs, 1053

Loriosis, 825

Loose-itch disease, 869

Lungs, collapse of in chest-wounds, 393
 effect of ligature of carotid on, 634
 of subclavian, 655
 examination of, before operation, 3
 hernia of, 396
 inflammation of. *See* **Pneumonia**
 pressure on, by aortic aneurism, 617
 rupture of, 390
 wounds of, 251, 390
 complications of, 391
 emphysema from, 391
 treatment of, 396
 empyema from, 392
 treatment of, 395
 hemorrhage from, 391
 treatment of, 395
 pneumonia from, 392
 treatment of, 395
 pneumothorax from, 391
 prognosis of, 393
 symptoms of, 390
 treatment of, 394

Lumbar division in imperforate anus, 1035
 region of cord, wounds of, 365
 hernia in, 1018

Lupoid ulcer, 554
 of cheeks, 859
 treatment of, 556

Lupus, 564
 diagnosis of, 555
 exedens, 554
 non-exedens, 554
 of nose, 855
 structure of, 556
 treatment of, 556

Lymph, 83
 absorption of, 84
 aplastic, 83
 causes modifying characters of, 84
 changes in, 84
 characters of, 83
 corpuscular, 83
 crampous, 83
 degeneration of, 86
 deposit of around abscess, 88
 development of, 84
 fibrinous, 83
 influence of general health on, 84
 organisation of plastic, 83
 varieties of, 83
 vascularisation of, 85

Lymphatic abscess, 415

Lymphatic glands of axilla, cancer of, 960
 of groin, enlarged, diagnosis from
 hernia, 1013
 inflammation of 560
 of neck, enlargement of, 865
 strumous disease of, 507, 501

Lymphatics, inflammation of, 559
 diagnosis from erysipelas, 451

Lymphatitis, 560

MAD ANIMALS, bites of, 139

Malar bone, fractures of, 249
 tumours growing from, 871

Malignant disease of amputation, 29,
 30

Malignant disease in stump, 27
 tumours, 469, 470 *See* **Cancer**,
 Encephaloid, Scirrhus, and
 Tumours

Malleoli, excision of, 783

Malnutrition a cause of scrofula, 509

Mammary abscess, 939, 940
 gland. *See* **Breast**
 tumour, chronic, 942
 painful, 944

Manipulation in aneurism, 613
 in subclavian aneurism, 643

Marian operation, 1100

Maxilla. *See* **Jaw**

Mastoid of ear, concretions in, 852

Median fissure of lip, 913
 lithotomy, 1160. *See* **Lithotomy**

Medullary membrane of bone, inflammation of, 704
 sarcoma, 456
 tumours of humerus, diagnosis of
 axillary aneurism, 661
 of parotid, 863

Melanosis, 482, 487

Mercury in acute inflammation, 72
 in chronic inflammation, 78
 syphilis, 521, 529, 536, 540, 543
 & &

- Metacarpophalangeal joints, amputation at, 34
 dislocation of, 313
 Metacarpus, amputation of, 36
 dislocation of, 312
 excision of, 770
 fractures of, 286
 Metastatic abscesses, 416
 Metastasis, 37
 Metatarsophalangeal joints, amputation at, 41
 Metatarsus, amputation at, 41
 dislocation of, 323
 excision of, 783
 Military Surgery, results of amputation in, 30, 32
 tetanus in, 698
 Milk, abnormal conditions of, 937
 abscess, 939
 diagnosis, from pus, 88
 secretion of, by the male, 963
 Miner's elbow, 815
 Moisture and warmth in inflammation, 74, 79
 Molecular death, 91, 92
 Mollities ossium, 721
 cause of, 722
 diagnosis of, 723
 seat of, 722
 structural changes in, 721
 symptoms of, 723
 treatment of, 723
 urine in, 723
 Mortality after amputation, 28
 after operation, causes of, 9
 Mortification, 97, 426. *See* Gangrene
 Mother's marks, 682
 Mouth, diseases of, 378
 erysipelas of, 459
 gangrenous disease of, 441
 hemorrhage from, in fractured jaw, 346
 injuries of, 374
 scabs of, 344
 scrofulous disease of, 507
 syphilitic disease of, 541, 548
 Mucopus, 86
 Mucous membranes, erysipelas of, 441
 inflammation of, secretions modified in, 83
 scrofula in, 507
 syphilis of, 541, 548
 ulcers on, 426
 polypi, 858
 tumours, 541
 Mucous, diagnosis from pus, 85
 Mulberry calculus, 1066
 Multilocular cysts, 474
 Mummification, 431
 Mumps, 86. *See* Parotitis
 Muscles, contractions of, 329
 diseases of, 821
 injuries of, 207
 repair of, 218
 ruptures of, 208
 spasms of, after fracture, 230
 strains of, 207

Neurastia (continued).

treatment of, 714

Necrosis of cranial bones, 718

jaws, 718, 863
larynx, 902
unsl bones, 855
patella, 720
pelvis, 718
ribs, 720
scapula, 718
sternum, 718
thigh-bone, 718
tibia, 718

Needles, hemorrhage arrested by pressure of, 169

punctured wounds from, 138

Nephritis, chronic, diagnosis from spinal caries, 789

Nerves, cerebral, laceration of, 355

contusion of, 207
division of, 207
effects of aneurism on, 585, 617
inflammation of, 692
injuries of, 207
puncture of, 207
section of, in neuralgia, 695
tumours on, 695

Nervous traumatic delirium, 104

Neuralgia, 692

causes of, 693
diagnosis of, 693
from aneurism, 691
from spinal caries, 789
section of nerves in, 695
situations of, 693
subcutaneous injection in, 694
symptoms of, 692
treatment of, 694

Neuralgia of breast, 936

hip, diagnosis from sacro-iliac disease, 795

joints, 755

testis, 1201

Neuritis, 632

Neuroma, 695

structure of, 695
traumatic, 696
treatment of, 696

Nipple, cracked, 949

inflammation of, 939
retraction of in cancer, 950
supernumerary, 936

Nitric acid applied to naevi, 683

Nodes, 543

Nose, abscess of, 854

bleeding from, 853

in fracture of bone of skull, 346

calculi in, 858

cancer of, 858

depressed, operation for, 912

diseases of, 853

epithelioma of, 855

fibrous tumours of, 858

fractures of, 855

fistulous openings into, 912

foreign bodies in, 871

Nose (continued)

fractures of, 248

gonorrhoeal inflammation of, 1161

lipoma of, 855

lymph of, 855

malignant tumours of, 858

naevus of, 857

necrosis of bones of, 855

plastic surgery of, 907

polyp of, 856

restoration of, 907

syphilitic disease of, 542

in infants, 548

thickening of membrane of, 854

Nucleus of calculi, 1061

Nunneley's classification of erysipelas, 448

Nutrition modified by inflammation, 64
states of, favouring ulceration, 92

OBLIQUE fracture. *See* Fracture

inguinal hernia, 1601

Obre's trachea tube, 933

Obstruction of air-passages, 379

intestinal, 1021. *See* Intestinal Obstruction

Obturator artery, relation to hernia, 1012

foramen, dislocation into, 319

hernia, 1019

Occipital bone, disease of, 792

Occlusion of arteries. *See* Arteries.

Oedema from congestion, 56

inflammatory, 456

of scrotum, 1199

from intrathoracic aneurism, 618

of larynx, 894

dysphagia from, 887

solid, 83

from tight bandaging, 231

Oedematous erysipelas, 450

laryngitis, 894

Esophagotomy, 390

Esophagus, foreign bodies in, 389, 888

injuries of, 889

structure of, 887

carcinomatous, 890

causes of, 890

diagnosis of, 887

fibrous, 889, 890

forms of, 889

hyssical, 889, 890

treatment of, 890

wounds of, 876, 889

Olecranon, fracture of, 261

Omentum in hernia, 998, 968

cysts in, 993

management of, 992

protruded, in wounds of abdomen, 405

Oncelma, 552

malignant, 552

simple, 552

syphilitic, 539

Opacity produced by inflammation, 68

Operations, 1

anæsthetics in, 0

causes of death after, 4

Operations (*continued*)

- circumstances influencing result of
- contraindications to performance of
- constitutional, preparation for, 8
- diet after, 17
- dressing of wound after, 16
- erysipelatous inflammation after, 447
- exhaustion after, 6
- gangrene after, 6
 - hospital, after, 439
- hemorrhage after, 6
- immediate precautions for, 8
- incisions for, 15
- internal inflammations after, 9
- performance of, 15
- preparations for, 7
- pyæmia after, 7
- results of, 2
- in scrofula, 512
- shock after, 5
- tetanus after, 6
- treatment after, 17
- Opium in gangrene, 432, 434
 - in inflammation, 72
 - poisoning by, diagnosis of traumatic coma from, 359
- Ophthalmia, gonorrhœal, 1159
- Ophthalmic artery, aneurism of, 642
- Orbit, aneurism in, 642
 - erysipelas of, 455
 - hemorrhage into, in fractured skull, 316
 - injuries of, 372
- Orchitis, 1291. *See* Testis, inflammation of
- Organic structure, 1146
- Orthopædic surgery, 830
- Os calcis, dislocation of, 329
 - excision of, 777
 - fractures of, 284
- Os magnum, dislocation of, 312
- Oseous anchylosis, 751
 - tumour of lower jaw, 875
 - upper jaw, 871
- Osteitis, 703
 - syphilitic, 543
- Osteo-aneurism, 732
 - characters of, 733
 - diagnosis of, 733
 - of humerus, diagnosis from aneurism, 651
 - symptoms of, 733
 - treatment of, 734
- Osteo-cancer, 729
 - diagnosis of, 730
 - forms of, 729
 - symptoms of, 729
 - treatment of, 731
- Osteo-cartilaginous tumour, 727
- Osteo-cephaloma, 729
- Osteoid cancer, 482, 729
- Osteoma, 727
- Osteomalacia, 721. *See* Mollities ossium
- Osteo-mycetis, 704
- Osteo-sarcoma, 727
- Osteorhiza, 703

- Penis** (*continued*)
 wounds of, 1126
 wounds of, 410
- Perchloride of iron in aneurism**, 615
 in bronchocele, 867
 in nevus, 883
 as neustytic, 164
 in varicose veins, 567
- Perforations in palate**, 923
- Pericardium, tapping the**, 935
 wounds of, 397
- Perineal abscess**, 1153, 1186
 fistula, 1189
 hernia, 1019
 incision in imperforate anus, 1036
 section, 1177
- Perineum, laceration of**, 411
 wounds of arteries of, in lithotomy, 1093
- Periosteum, bruising of**, 209
- Periostitis**, 793
 syphilitic, 543
- Peritonitis, erysipelatosus**, 460
 with hernia, 980
 after hernia operations, 989
 after lithotomy, 1100
 traumatic, 407
- Permanent arrest of hemorrhage**, 161, 164
- Permeable structures**, 1177
- Peroneal artery, wounds of**, 200
- Petit's operation**, 997
- Phagedæna, gangrenous**, 517
 sloughing, 437
 causes of, 439
 signs of, 437
 symptoms of, 438
 treatment of, 439
- Phagedæm chatere**, 516. *See* Chancre
- Pharyngotomy**, 390
- Pharynx, abscess behind**, 880
 cancer of, 880
 diseases of, 886
 epithelioma of, 886
 foreign bodies in, 389
 inflammation of, 886
 injuries of, 374
 polypus in, 886
 dysphagia from, 897
 scales of, 384
 syphilitic disease of, 541
 tumours of, 886
 behind, dysphagia from, 867
- Phimosis**, 1193
 circumcision for, 1194
- Phlebotomy**, 562
 adhesive, 563
 connection of pyæmia with, 465
 diagnosis from erysipelas, 451
 from lymphatitis, 559
 diffuse, 154, 564
 pathology of, 563
 secondary hemorrhage from, after
 ligature, 179
 suppurative, 564
- Phlegmon**, 63
- Phlegmonous abscess**, 414
 erysipelas, 448
- Phosphatic cal-culi**, 1067, 1068
 lithosis, 1067
- Phosphorus, necrosis of jaws from**, 868
- Phrenic hernia**, 1920
 nerve, effect of injury of, 366, 656
- Phthisis complicating fistula in ano**, 1048
 laryngeal, 896, 902
- Piles, blind**, 1050
 causes of, exciting, 1052
 predisposing, 1050
 caustics in, 1060
 coagulation in, 1056
 complications of, 1056
 diagnosis of, 1056
 excision of, 1059
 external, 1050, 1053
 fleshy, 1053
 globular, 1054
 hemorrhage from, 1054
 diagnosis of, 1057
 internal, 1050, 1053
 inter-external, 1050
 ligature of, 1059
 longitudinal, 1053
 sphacelus of, 1056
 structure of, 1052
 subsidence of, 1056
 suppuration of, 1056
 symptoms of, 1053, 1054
 terminations of, 1056
 treatment of, 1057
- Pilocystic tumours**, 474
- Pins, in hare-lip operations**, 915
- Pirogoff's amputation of foot**, 45
- Pisiform bone, dislocation of**, 712
- Plantar arteries, wounds of**, 200
 fascia, contraction of, 847
- Plasters**, 113
 after operations, 16
- Plaster of Paris bandage**, 230
- Plastic lymph**, 83
 deposits in arteries, 572
 in larynx, 902
 operations on contracted cicatrices, 150
- Plastic surgery**, 904
 of eyelids, 906
 lips, 913
 nose, 907
 palate, 920
- Pleura, accumulation of air in**, 391
 extravasation of blood into, 391, 395
 inflammation of, after ligature of
 subclavian, 356
 pus in, 392
 tapping the, 933
- Pliers, cutting**, 716
- Plugging nostrils**, 853
- Pneumothorax**, 396
- Pneumonia, congestive**, 77
 in cut throat, 377
 from foreign bodies, 380
 after ligature of arteries, 634, 656
 traumatic, 392
- Pneumothorax**, 391
- Pointing of abscesses**, 414

- Pilon's wounds, 137
 Pilon's operation for staphylococci,
 Polypi, 475
 in bladder, 1137
 cat, 853
 frontal sinuses, 853
 larynx, 903
 nasal, 856
 diagnosis of, 857
 history, 856
 gelatinous, 856
 malignant, 858
 mucous, 856
 sarcomatous, 856
 symptoms of, 856
 treatment of, 857
 varieties of, 856
 pharyngeal, 886
 dysphagia from, 887
 of rectum, 1041
 diagnosis from piles, 1057
 structure of, 475
 in urethra, 1191
 uterine, 1232
 in vagina, 1229
 Popliteal aneurism, 871. *See* Aneurism
 Posterior curvature of spine, 829
 Proctitis, 1198
 Potass. pur. in chronic abscess, 421
 Pott's fracture, 282
 Prolapses, 118
 Prostate, diseases of, 1193
 herpes of, 1196
 diagnosis from chancre, 518
 hypertrophy of, 1193
 inflammation of, 1196
 malformation of, 1193
 Pressure in chronic inflammation, 81
 in hemorrhage, 165
 Pressure effects of aneurism, 585
 of innominate artery, 638
 intracranial aneurism, 620
 intrathoracic aneurism, 618
 Primary adhesion, 116
 amputations, 31
 bones, 529
 hemorrhage. *See* Hemorrhage
 syphilis, 513
 Probing for larynx, 896
 Propetiles, direction and force of, 123
 Prone tongue, 878
 Prolapsus ani, 1061
 causes of, 1061
 diagnosis of, 1062
 from piles, 1056
 ligature of, 1064
 treatment of, 1062
 of uterus, 1231
 Prohibitions, 474
 Prostatitis, abscess of, 1143
 calculus in, 1128
 cancer of, 1151
 dilatation of, in median lithotomy,
 1104
 disease of, producing irritability
 der, 1135
 diseases of, 1142

- Pus** (*continued*).
 within skull, 335
 treatment of, 339
- Pustules**, syphilitic, 539
- Putrescent animal matter**, wounds inoculated with, 143
- Pyæmia**, 461
 arthritis from, 740
 a cause of death after operation, 3, 7, 461
 causes of, 461
 changes of blood in, 464
 diagnosis of, 464
 formation of purulent deposits in, 464
 in injuries of head, 330
 treatment of, 341
 pathology of, 464
 phenomena of, 462
 pus-cells in, 87
 symptoms of, 462
 treatment of, 467
- Pyogenic membrane**, 88
- Pyogenesis**, 87
- Pyrexia**, 64
- QUILLED suture**, 112
- RAMES**, 139
- Radial artery** *See* Artery, radial
- Radical cure of hernia**, 970
 of varicocèle, 1214
- Radius**, dislocations of, 307
 excision of, 767
 fracture of, 262
- Ranula**, 883
- Rattlesnake**, 138
- Reaction from shock**, 101
- Rectangular staff**, 1101
- Rectocèle**, 1239
- Recto vaginal fistula**, 1041
- Recto-vesical fistula**, 1041
- Rectum**, absence of, 1035
 cancer of, 1039
 cauliflower growth in, 1039
 fibro-plastic tumour of, 1040
 fistulous openings into, 1041
 foreign bodies in, 411
 malformations of, 1034
 opening of into other canals, 1037
 polyp of, 1041, 1057
 puncture through the, 1150, 1163
 scirrhus of, 1039
 structure of, fibrous, 1037
 malignant, 1039
 wound of, in lithotomy, 1095, 1104
- Red particles of blood**, changes of, in inflammation, 60
- Redness of parts in inflammation**, 62
- Reducible hernia**, 969. *See* Hernia
 tumours of groin, 1033
- Reduction of dislocations**, 287
 of fractures, 224
 hernia, 980. *See* Hernia.
- Reef-knot**, 172
- Reynold's operation on the tongue**, 882
- Renal calculus**, 1069
- Resection** *See* Excision
 in necrosis, 718
- Resin plaster**, 113
- Resolution of inflammation**, 66
- Respiration**, artificial, 380
- Retention of urine**. *See* Urine
- Retractors in amputation**, 22
- Retroverted uterus**, 1231
- Rheumatic arthritis**, chronic, 746
- Rheumatism**, diagnosis, from aneurism, 591
 from hip-disease, 806
 from osteomalacia, 723
 from caries of spine, 789
 gonorrhœal, 1161
- Rhinoplastic operations**, 907
- Ribs**, fractures of, 250
 necrosis of, 720
- Rickets**, 720
 diagnosis from osteomalacia, 723
 of pelvic bones, complicating lithotomy, 1091
 treatment of, 721
- Roseola**, syphilitic, 538
- Rupture of abdominal viscera**, 399
 of aneurism, 592
 arteries, 154, 577
 bladder, 498
 heart, 398
 lung, 390
 muscles and tendons, 208
 ureter, 409
- SAC OF HERNIA**, 965 *See* Hernia
 lachrymal, puncture of, 819
- Sacculated aneurism**, 582
 bladder, 1071, 1077
 difficulties in lithotomy and lithotripsy from, 1096, 1124
- Sacro-iliac articulation**, dislocation of, 314
 disease of, 792
 abscess in, 795
 alteration in shape of limb, 794
 diagnosis of, 795
 laceration in, 794
 pain in, 794
 pathology of, 793
 prognosis of, 795
 symptoms of, 794
 treatment of, 796
- Sacrum**, fractures of, 267
- Salivary fistula**, 371, 869
- Sanguineous cysts**, 474, 948
 tumours of bone, 732
- Sanious pus**, 86
- Sarsaparilla in chronic inflammation**, 79
- Sarcocèle**, 1216
 cystic, 1219
 diagnosis of, 1223
 malignant, 1219
 simple, 1216
 syphilitic, 545, 1219
 tuberculous, 1217
- Sarcoma**, albugineous, 479
 cystic, 946
 medullary, 486

- Sarcomatous growths, 175
 polypus, 856
 Sarsaparilla in chronic inflammation, 79
 Saw, amputating, 20
 application of, 21
 Butcher's, 750
 for necrosis, 716
 Scabbing, 169
 Scalds, 145
 of mouth and throat, 384
 Scalp, contusion of, 341
 extravasation under, 341
 injury of, 341
 necrosis of, 386
 wounds of, 342
 Scapulae, 20
 Scaphoid bone, dislocation of, 329
 excision of, 783
 Scapula, dislocations of, 298
 excision of, 702
 fracture of, 255
 necrosis of, 718
 Scar. *See* Cratrix
 Schneiderian membrane, thickening of, 854
 diagnosis from polypus, 857
 Sciatic artery, aneurism of, 669
 hernia, 1020
 Sciatica, diagnosis from sacro-iliac disease, 795
 Scirrhous, 482, 485.
 diagnosis from aneurism, 590
 of anus, 1041
 breast, 949. *See* Breast
 parotid gland, 562
 penis, 1186
 rectum, 1039
 tongue, 880
 Scleritis, gonorrhoeal, 1160
 Scoop, lithotomy, 1079
 Scrofula, 505
 in bones and joints, 507, 720
 causes of, 508
 in glandular organs, 507
 indicated in treatment of, 508
 local manifestations of, 508
 in mucous membrane, 507
 operation in, 512
 in skin, 508
 treatment of, 509
 Scrofulous testicles, 505
 tumour, 505
 testicle, 1217
 Scrotal fistula, 1188
 hernia, 1163
 Scrotum, cancer of, 1200
 diagnosis of tumours of, 1216
 diseases of, 1199
 elephantiasis of, 1199
 erysipelas of, 456
 hypertrophy of, 1199
 inflammatory oedema of, 456, 1199
 Searcher, lithotomy, 1079
 Season, influence of on hospital gangrene, 446
 Sebaceous tumours, 470
 Secondary adhesions, 114
 amputation of
 aneurism of, 676
 hemorrhage after ligature
 scapula, 591
 Secretions, changes in, 82
 Seminal vesicles, tumours, 1064
 Semimembranous testis, 1064
 Seminal duct, 1224
 Semilogangrene, 431 *See* Gangrene
 Sensibility, increase of in aneurism, 63
 Separation, line of, in gangrene
 Septum cecale, 1011
 Septum of nose, abscess of
 from polypus, 567
 fracture of, 245
 Sequestrum, 710
 removal of, 715
 Sero-cystic tumour of breast, 949
 Sero-mucous cyst of breast, 949
 Sero-pus, 86
 Serous cysts, 474
 membranes, effusions in
 tissue of, 82
 erysipelas of, 460
 Serpiginous ulcer, 544
 Serratus, 118, 905
 Serum, effusion of, 82
 turbid, diagnosis from polypus
 Seton, 80, 421
 in hydrocele, 1209
 Serratus piers, 228
 Shock, 101
 chloroform in, 13
 in gun-shot wounds, 126
 after operations, 5
 treatment of, 124
 Shot, irregularly, 123
 Shoulder-joint, amputation of
 chronic rheumatoid arthritis
 dislocations of, 298
 excision of, 761
 fracture of, 255
 gun-shot wounds of, 123
 Sight affected by intra-ocular
 tumours, 639
 Silvester's method of artificial
 respiration, 387
 Sims's operation for varicocele,
 1190
 Sinus, 422
 frontal disease of, 858
 in hypopharynx, 709
 Skin, cancer of, 557
 chloroform in, 553
 diseases of, 553
 in hypopharynx, 709
 general in carcinoma of
 malignant tumours and
 553
 scrofula of, 506
 syphilis of, 553
 in infants, 548
 tumours of, 175
 venous, with glands
 Skull, aneurism in, 667

Skull (*continued*).

- contusion of, 343
- extravasation in, 367
- foreign bodies in, 365
- fractures of, 344
 - of base of, 345
 - causes of, 344
 - by contrecoup, 344
 - depressed, 348
 - punctured, 349
 - simple, 344
- fungus of, 349
- necrosis of, 718
- suppuration within, 335, 339
- trephining the. *See* Trephining
- Sliding tubes for dilating stricture, 1174
- Sloughing of aneurisms, 592, 603
- chancre, 617. *See* Chancre
- phagedæna, 437. *See* Phagedæna ulcer, 425
- Sloughs, 426
 - in contused wounds, 115, 118
 - formation of, 97
 - separation of, 98, 115
- Slugs, injuries from, 123
- Snake-bites, 137
 - symptoms of, 138
 - treatment of, 138
 - poison, effects of, 138
- Snow's chloroform inhalers, 11
- Soap-plaster, 113
- Softening, 97
 - of bone, 721
- Soft cancer, 482
 - chancre, 515, 521, 524
 - polypus, 556
- Sounding for stone, 1074, 1110
 - errors in, 1077
- Sounds for lithotomy, 1074
 - lithotrixy, 1110
 - urethral stricture, 1169
- Spasm of muscles after fracture, 230
- Spasmodic group, 903
 - spermatorrhœa, 1225
 - stricture of œsophagus, 889
 - urethra, 1165
- Specific inflammations, 63
- Speculum ani, 1001
 - vagine, 1226
- Spermaspasmus, 1225
- Spermatic cord, hernatocele of, 1212
 - diagnosis from hernia, 1005
 - hydrocele of, 1211
 - diagnosis from inguinal hernia, 1004
 - relations of to hernia, 1002, 1003
 - tumours on, diagnosis from hernia, 1005
 - varix of, 1213
- Spermatorrhœa, 1224
 - spasmodic, 1225
 - true, 1224
- Spermatozoa in fluid of hydrocele, 1210
- Sphacelus, 426
 - of piles, 1056
- Sphincter ani, spasmodic constriction of, 1045

- Spina bifida, 785
 - treatment of, 786
 - ventosa, 727
- Spinal cord, concussion of, 362
 - division of, 365
 - wounds of, 364
- Spine, abscess of, 788
 - angular curvature of, 787
 - caries of, 786
 - changes in vertebrae by, 786
 - diagnosis of, 789
 - from sacro-tibial disease, 790
 - prognosis of, 790
 - symptoms of, 787
 - treatment of, 790
 - diseases of, 785
 - dislocations of, 369
 - fractures of, 367
 - injuries of, 362
 - complicating fracture of skull, 362
 - lateral curvature of, 823
 - causes of, 825
 - diagnosis from hip-disease, 806
 - mechanical contrivances for, 828
 - mechanism of, 824
 - signs of, 828
 - treatment of, 827
 - sprains of, 366
- Splay foot, 847
- Splinters in gunshot wounds, 123
 - removal of, 129
- Splints, 226
 - Dupuytren's, 283
 - gutta-percha, 249
- Sponge probang, introduction of into larynx, 896
- Spongy exostosis, 726
 - ulceration of gums, 867
- Spontaneous dislocations, 294
 - fractures, 216
 - gangrene, 430, 571
 - hematocele, 1211
- Sprains, 207, 210
 - of spine, 366
- Squame, syphilitic, 533
- Squint, 832
- Staff for lithotomy, 1078
 - rectangular, 1101
- Staphylocoraphy, 920
 - Ferguson's operation, 921
 - Pollock's operation, 922
- Starched bandage in fractures, 227
 - application to fracture of leg, 293
 - thigh, 276
- Stratoma, 572
- Stenonian duct, fistula of, 371
- Sternum, fractures of, 252
 - necrosis of, 718
- Sthenic inflammation, 65
- Stimulants in low inflammations, 70
- Stings, 137
- Stomach, rupture of, 361
- Stomatitis, gangrenous, 441
 - syphilitic, in children, 549
- Stone. *See* Calculus
- Strabismus, 832

- Strains, 207
 Strangulated hernia. *See* Hernia
 Strangulation, 197
 gangrene from, 428
 Strangury, 1133
 Strapping the testis, 1903
 Stratiform melanosis, 447
 Stricture of oesophagus, 887. *See* Oesophagus
 intestinal, diagnosis of, 1025
 rectum, 1037. *See* Rectum
 urethra, 1163. *See* Urethra
 Struma. *See* Scrofula
 Strumous arthritis, 749. *See* White Swelling
 disease of stumps, 27
 inflammation, 68, 506
 enlargement of glands, 561
 Stumps, aneurism of, 27
 conical, 26
 degeneration of, 27
 dressing of, 23
 erysipelas of, 23
 fatty, 27
 malignant, 27
 morbid states of, 26
 necrosis of, 26
 painful, 27
 secondary hemorrhage from, 23, 179, 181
 sloughing of, 23
 apostrophic, 27
 structure of, 25
 strumous, 27
 sugar-loaf, 26
 Styles for dilating urethral stricture, 1171
 Styptics, 164
 Subacute inflammation, 68
 Subaponeurotic cephalæmatoma, 341
 Subastragaloid amputation, 46
 Subclavian artery. *See* Aneurism, and Artery, Subclavian
 vein. *See* Vein
 Subclavicular dislocation, 300
 Subcoracoid dislocation, 298
 Subglenoid dislocation, 300
 Subluxation of lower jaw, 296
 of knee, 324
 Submammary abscess, 939
 Submaxillary space, tumours in, 864
 Subperiosteal cephalæmatoma, 342
 Subpycnous dislocation, 300
 Sugar loaf stumps, 26
 Supernumerary nipples, 936
 Suppuration, 66
 causes of, 89
 duration of, 88
 hectic in, 89
 symptoms of, 89
 treatment of, 90
 Suppuration of aneurismal sac, 592, 603
 in axillary aneurism, 666
 iliac aneurism, 664
 antrum, 870
 of bone, 704
 breast, 939
 in burns, 148
 Suppuration (*continued*).
 of bursa patellar, 817
 hemorrhoids, 1056
 in hip disease, 799, 803
 interstitial, 335, 336
 in joints, 213, 739, 745
 nose, 854
 of piles, 1066
 in sacro-iliac disease, 795
 of scrotum, 1203
 in spinal disease, 788
 of tongue, 878
 Suppurative inflammation, 86
 phlebitis, 564
 Supranammary abscess, 939
 Suprapubic lithotomy, 1108
 in females, 1130
 Surgeon, responsibility of, 6
 Sutures, 16, 112
 in amputation, 23
 headed, 112
 button, 1191
 continuous, 112
 figure of 9, 112
 in barehip, 915, 917
 interrupted, 112
 materials for, 112
 quilled, 112
 in wounded intestine, 603
 Swelling in inflammation, 62
 Symblepharon, operation for, 96
 Syme's amputation of foot, 44
 operation for structure, 1172
 Symphysis pubis, dislocations of
 Syncope from chloroform, 14
 Synovial membrane, diseases of,
 inflammation of, 736
 Synovitis, 735
 acute, 736
 causes of, 735
 chronic, 736
 pathology of, 736
 symptoms of, 736
 terminations of, 737
 treatment of, 737
 Syphilides, 538
 Syphus, 513
 congenital, 549
 consecutive, 527. *See* Boils, Trices, and Warts
 constitutional, 531
 in females, 514, 546
 infants, 546
 contamination of, 547
 phenomena of, 547
 symptoms of, 548
 teeth affected by, 549
 treatment of, 549
 inoculation of, 514
 mercury in, 521, 536
 primary, 513. *See* Chancre
 secondary, 531
 characters of, 531
 circumstances in which it is caused, 532
 local manifestations of,
 mercury in, 536

Syphilis (continued).

- secondary, phenomena of, 533
 - progress of, 531
 - transmissibility of, 531
 - treatment of, 535
- tertiary, 532
- Syphilitic alopecia, 539
 - locks, 539
 - hairs, 549
 - canes, 544, 708
 - condylomata, 540
 - disease of bones, 543
 - of hair and nails, 539
 - larynx, 542
 - lips, 518, 541
 - mouth, 541
 - mucous membranes, 541, 548
 - muscles and tendons, 546
 - nose, 542, 548
 - pericardium, 543
 - pharynx, 541
 - skin, 538, 548
 - testis, 545
 - throat, 541
 - tongue, 541
 - exanthemata, 538, 541
 - excrescences, 540
 - iris, 543
 - muscular tubercle, 540
 - necrosis, 544
 - nodes, 543
 - onychitis, 539
 - osteitis, 543
 - ovariitis, 546
 - periostitis, 543
 - pastas, 539
 - roses, 538
 - sarcocele, 545, 1219
 - squamous, 538
 - stomatitis, 548
 - teeth, 549
 - tubercles, 541, 548
 - on tongue, 579
 - ulceration of tongue, diagnosis from cancer, 880
 - ulcers, 539
 - vegetations, 540
 - vesicles, 539, 549
 - warts, 540
- Syphilo-dermata, 538
- Syringe, laryngeal, 901

TACLIACOTIAN OPERATION, 908

- Talipes, 844
 - calcaneo-valgus, 847
 - calcanus, 845
 - equinus, 846
 - valgus, 847
 - varus, 846
- Tanjore pill, 139
- Tapping the abdomen, 1032
 - abscesses, 421
 - the chest, 933
 - hydrocele, 1206
 - ovarian tumours, 1233
 - the pericardium, 935

- Tarantula, 137
- Tarsus, amputation through, 43
 - dislocations of, 326, 329
 - excisions of, 777
- Taxis, 980
- Teeth, syphilitic affection of, 549
- Teale's amputation, 23
- Telegraph wire for sutures, 112
- Temperament, scrofulous, 505
- Temperature, increase of, in inflammation, 63
- Temporal artery, aneurism of, 193
- Tenderness in inflammation, 63
- Tendo Achillis, division of, 845
 - rupture of, 209
- Tendons, diseases of sheaths of, 820
 - division of, 830, 842
 - hamstring, contraction of, 842
 - inflammation of sheath of, 821
 - injuries of, 207
 - repair of, 208, 831
 - rupture of, 208
 - sprains of, 207
 - syphilitic disease of, 546
- Tenosynovitis, 821
- Tenotomy, 830
- Tertiary syphilis, 532
- Testis, abscess of, 1203
 - cancer of, 1219
 - castration in, 1221
 - cystic disease of, 1219
 - inflammation of, 1201
 - gonorrhoeal, 1159
 - in inguinal canal, 1009, 1203
 - sent of, 1201
 - subacute, 1203
 - symptoms of, 1202
 - treatment, 1202
 - malposition of, 1200
 - neuralgia of, 1201
 - relation to inguinal hernia, 1003
 - scrofulous, 1217
 - syphilitic disease of, 545
 - strapping the, 1203
 - tumours of, 1216
 - diagnosis from hernia, 1006
 - undescended, diagnosis from inguinal hernia, 1045
 - from congenital hernia, 1008
- Tetanus, 696
 - a cause of death in operations, 6
 - causes of, 697
 - forms of, 697, 699
 - pathology of, 700
 - period of occurrence of, 698
 - symptoms of, 699
 - traumatic, 697
 - treatment of, 701
- Thigh, amputation of, 50
 - arteries of, wounded, 190
 - gun-shot wounds of, 133
- Thigh-bone, dislocations of, 314
 - in hip-disease, 800
 - excision of head of, 808
 - results of, 812
 - fractures of, 268
 - necrosis of, 718

- Thompson's stricture expander,
 Throat, diseases of, 375
 syphilitic disease of, 541
 Thumb, amputation of, 36
 dislocations of, 312, 313
 excision of, 759
 gun-st. d. wounds of, 120
 Thyroid gland, diseases of, 865
 diagnosis from aneurism
 Tibia, dislocations of, 823, 840
 excision of, 773
 fractures of, 280
 necrosis of, 718
 Tibial artery, ligature of, 679
 Toe nail, hypertrophy of, 553
 ingrowing of, 552
 Toes, amputations of, 41
 contraction of, 847
 dislocations of, 330
 excision of, 783
 Tongue, abscess of, 879
 aneurism by anastomosis in,
 cancer of, 880
 removal by écraseur, 880
 ligature, 881
 diseases of, 878
 encephaloid of, 880
 encysted tumour of, 884
 epidermis of, diseased, 879
 epithelioma of, 880
 fissures of, 879
 inflammation of, 878
 navus of, 689, 878, 883
 pedicle of, 878
 psoriasis of, 879
 ranula in, 883
 removal of, 880
 Requien's operation, 889
 scurfiness in, 889
 syphilitic disease of, 518, 541
 tubercle of, 879
 tie, 878
 tumours of, 880, 883
 wart-like appearance of, 879
 wounds of, 374
 Tonsillitis, 885
 Tonsils, diseases of, 884
 hypertrophy of, 885
 inflammation of, 885
 removal of, 885
 Tophi, 552
 Torsion of arteries, 165
 Torticollis, 833
 Tourniquet in amputation, 19
 in dislocation, 288
 in hemorrhage, 163
 Trachea, foreign bodies in, 379
 operations on, 923 *See Larynx*
 and Tracheotomy
 pressure on by aneurism, 617
 by dislocated clavicle
 wounds of, 376
 Trachea forceps, 930
 hooks, 929
 tubes, 929, 932
 Wire s., 933
 Tracheotomy, 930

Tumours (continued)

- enchondromatous, 480. *See* Enchondroma
 - encysted, 470. *See* Cystic Tumours
 - erectile, 682. *See* Nævus
 - excision of, 503
 - fatty, 476. *See* Fatty Tumours
 - fibro-cellular, 477
 - fibro-cystic. *See* Fibro-cystic Tumours
 - fibro-plastic, 479
 - fibrous, 478
 - malignant, 479
 - fibro-vascular, 553
 - innocent, 464
 - malignant, 469, 479. *See* Cancer and Epithelioma
 - melanotic. *See* Melanosis
 - mucous, simple, 475
 - myeloid, 479
 - non-malignant, 468, 470
 - pilocystic, 474
 - pulsating, diagnosis from aneurism, 539
 - recurring fibroid, 479
 - sarcomatous, 475
 - scirrhus. *See* Cancer and Scirrhus
 - sebaceous, 470
 - semimalignant, 469, 479
 - varieties of, 468
 - warty, of cicatrices, 152, 475, 553
- Tumours of alveoli, 867**
- antrum, 871
 - in axilla, 963
 - diagnosis from aneurism, 651
 - of bladder, 1137
 - bone, 726
 - breast, 942
 - horse, 814, 818
 - cheeks, 859
 - dura mater, 848
 - external ear, 852
 - eyelids, 849
 - groin, 1032
 - diagnosis from aneurism, 663
 - from hernia, 1005, 1013
 - treatment of, 1033
 - of gums, 867
 - hemorrhoidal, 1056. *See* Piles
 - intrathoracic, dysphagia from, 888
 - of jaw, lower, 875
 - upper, 871
 - labia, 1227
 - lactal, 938
 - of larynx, 903
 - lips, 860
 - malar bone, 871
 - muscles, 821
 - neck, 864
 - diagnosis from aneurism, 629
 - nerves, 605
 - nose, 856
 - ovaries, 1233
 - parotid gland, 861
 - penis, 1100
 - pharynx, 886, 887
 - in popliteal space, diagnosis from aneurism, 671

Tumours (continued).

- of prostate, 1145
 - rectum, 1049
 - scalp, 341
 - scrotum, 1222
 - spermatic cord, diagnosis from
 - hernia, 1005
 - in submaxillary space, 864
 - of testis, 1216
 - thyroid body, 865
 - tongue, 850, 883
 - urethra, 1111
 - uterus, 1232
 - vagina, 1229
- Tunica vaginalis, hernia in, 1008**
- encysted, 1010
 - hydrocele of, 1204
 - diagnosis of, 1005, 1219, 1223
- Twisted suture, 112**
- Tympanic abscess, 416**
- Typhoid fever, diagnosis from pyæmia, 404**

ULCER, 91, 423

- cicatrisation of, 95
- definition of, 91
- diagnosis of, 96
- granulation of, 94
- healthy, 423
- hemorrhagic, 426
- indolent, 424
- inflamed, 425
- irritable, 425
- lipoid, 554, 556
- on mucous membranes, 426
- purulent, 423
- repair of, 93
- sloughing, 425
- sphilitic, 539, 541
- treatment of, 96
- varicose, 425
- varieties of, 423
- weak, 424

Ulcer of anus, 1043

- bone, syphilitic, 544
- cheeks, canceroid, 859
- duodenum, after burns, 147
- gums, 867
- larynx, 902
- lips, 859
- mouth, phagedænic, 441
- nose, 855
- tongue, sloughing, 880
 - syphilitic, 880

Ulceration, 91

- arrest of, 93
- causes of, 92
- cicatrisation of, 95
- extension of, 93
- modes of commencement of, 92
- nature of, 91
- spreading of, 93
- stages of, 93
- treatment of, 96
- of arteries, 777
 - cancer, 484
 - cartilage, 743

- Ulcerative inflammation, 91
 Ulna, dislocations of, 307
 excision of, 787
 fractures of, 281
 Ulnar artery. *See* Artery, ulnar
 Umbilical hernia, 1016
 Union by first intention, 109, 110
 of fractured bone, 221
 delayed, 242
 by granulation, 111
 of incised wounds, 108
 nerves, 207
 by scabbing, 100
 second intention, 111
 of tendons, 208, 331
 Urethroplasty, 922
 Ununited fracture, 243
 Ureter, dilatation of, 1167
 rupture of, 409
 Urethra, abscess of, 1152
 bulb of, wounded, 1095, 1103
 calculus in, 1127
 broken, impacted in, 1117
 chancres of, 517
 dilatation of in calculus, 1077
 behind stricture, 1167
 in treatment of stricture, 1169
 exploration of, 1163
 false passages in, 1172
 female, dilatation of, 1129
 tumours of, 1192
 fistulous opening into, 1189
 foreign bodies in, 409
 hemorrhage from, 1188
 — after catheterism, 1172
 in gonorrhoea, 1158
 inflammation of, 1152
 specific, 1153. *See* Gonorrhoea
 internal insertion of, 1175
 laceration of, 410
 missing the, in lithotomy, 1095
 muscular structure of, 1163
 opening the, 1175, 1177
 plastic operation on, 1188
 polypi of, 1191
 rectum opening into, 1037
 stricture of, 1163
 catheterism in, 1169
 accidents attending, 1172
 forcible, 1182
 caustics in, 1173
 characters of, 1163, 1166
 complications and results of, 1181
 congestive, 1165
 dilatation of, 1169
 division of, external, 1177, 1180
 internal, 1175
 extravasation of urine in, 1091
 impedes lithotomy, 1125
 inoperable, operation for, 1179
 local signs of, 1163
 organs, 1166
 permeable, 1177
 results of, 1167
 seat of, 1166
 spasmodic, 1168
 symptoms of, 1168
 Urethra, stricture of, *see*
 treatment of, *see*
 tumours of, 1181
 wound of, 410
 Urethral lithotomy, 1125
 lithotrity, 1127
 Urethritis, 1153
 Urethroplasty, 1188
 Urethrotomy, 1176
 Urethrotomy, in unpermeable
 1189
 internal, 1175
 perineal, 1177
 in retention of urine
 for urinary fistula,
 Urethro-vaginal fistula,
 Uric acid. *See* Lithic
 Urinary abscess, 1166
 calculus, 1064
 fistula, 1187, 1189
 organs, foreign bodies
 states of, in
 of operation
 vaginal fistula, 1189
 Urine, blood in, 1153
 deposits in, 1064
 extravasation of, 41,
 effects of, 1185
 treatment of, 41
 flow of, impeded by
 incontinence of, 116
 hysterical, 116
 irritable bladder from
 of, 1134
 in mollities ossium,
 retention of, from
 1139
 from enlarged prostate
 treatment of
 from gonorrhoea
 hysterical, 116
 from prostatitis
 structure of
 organs
 forcible
 pancreas
 the
 urethra
 spasmodic, 116
 suppressed after lithotomy
 Uterus, absence of, 1226
 anteversion of, 1231
 cancer of, 1232
 cauliflower excrescence
 chronic inflammation
 discharges from, 1230
 displacements of, 1231
 fibrous tumours of,
 polypi of, 1232
 prolapse of, 1231
 retroversion of, 1231
 ulceration of, 1230
 Uvula, elongation of, 1234
 excision of, 864

- VAGINA**, discharge from, 1230
 in children, 1162, 1231
 diseases of, 1227
 fistulous openings into, 1041, 1189
 foreign bodies in, 411
 imperforate, 1228
 introduction of speculum, 1227
 prolapsus of, 1229
 rectum opening into, 1037
 tumours of, 1229
- Vaginal hernia**, 1020
 lithotomy, 1139
- Valsalva's treatment of aneurism**, 594
- Varicocele**, 1213
 diagnosis of, 1213, 1222
 from hernia, 1005
 radical cure of, 1214
 symptoms of, 1213
 treatment of, 1214
- Varicose aneurism**, 189
 symptoms of, 190
 treatment of, 191
- ulcer**, 425
- Varix of absorbent vessels**, 562
 aneurismal, 189, 615
 of arm, 197
 in neck, 192, 627
 in a stump, 27
 of subclavian, 193
 treatment of, 189
- of veins**, appearance of, 565
 causes of, 565
 compression of veins in, 568
 diagnosis from aneurism, 628
 femoral hernia, 1013
 injection of, 567
 locality of, 565
 structure of, 566
 treatment of, 566
- Vascularisation of granulations**, 94
 of lymph, 85
- Vegetations**, syphilitic, 540
- Vein**, femoral, wound of in operation, 674
 jugular, aneurismal varix of, 192
 saphena, varix of, diagnosis from
 femoral hernia, 1013
- subclavian**, aneurismal varix of, 193
- Veins**, air in, 201. *See* Air in Veins
 canalisation of, 203
 diseases of, 562
 gangrene from obstruction of, 481
 hemorrhage from, 154, 156
 during lithotomy, 1094
 inflammation of, 562. *See* Phlebitis
 injuries of, 154
 obliteration of, in phlebitis, 567
 pressure of aneurism on, 585, 618, 620
 of rectum, states of causing piles,
 1056
 varicose, 565. *See* Varix
 wounds of, 154
 communicating with arteries,
 189
- Vena cava**, wounds of, 398
- Venereal disease**, 513. *See* Syphilis
- Venous nevi**, 632
- Ventilation**, imperfect, a cause of erysipelas, 447
 importance of, in surgery, 4
- Ventral hernia**, 1018
- Vermore's amputation**, 51
- Verruæ**. *See* Warts
- Vertebrae**. *See* Spine
 dislocation of, 369
- Vertebral arteries**, aneurism of, 637
- Vesical catarrh**, 1133
 treatment of, 1136
- Vesicles**, syphilitic, 539
- Vesico-vaginal fistula**, 1041, 1189
- Viscera**, abdominal, injuries of, 390
- Volvulus**, 1025
- Vornice**, tuberculous, in bone, 723
- Vomiting**, of blood in fractured skull, 346
 in intestinal obstruction, 1923, 1924
 strangulated hernia, 978, 979
- Vulsellum-scissors**, 884
- Vulva**, nevus of, 689
- WAXLEY'S stricture-dilator**, 1174
- Warmth** in inflammation, 74, 79
- Warts**, 475, 550
 gonorrhoeal, 1159
 on labia, 1227
 lips, 869
 penis, 1196
 fungoid, diagnosis from epithelioma, 1197
 scirrhus, 558
 on tongue, 879
 venereal, 530, 540
- Warty condition of joints**, 753
 tumours of cicatrices, 153, 475, 553
- Wasp**, stings of, 137
- Water-dressing**, 74
- Weak ankles**, 848
 ulcer, 424
- Weiss's lithotrite**, 1110
- Wens**, 475
- White-swelling**, 749
 pathology of, 749
 symptoms of, 749
 treatment of, 750
- Whitlow**, 456
 treatment of, 457
- Wind-contusions**, 125
- Wind pipe**, operations on, 924
- Wood's operation for hernia**, 973
- Worm eaten caries**, 544
- Wounds**, 108
 arterio-venous, 189
 contused, 114
 dissection, 143
 dressing of, 16, 23, 111
 erysipelas caused by, 447
 gun shot, 122. *See* Gun-shot wounds
 incised, 108
 lacerated, 114
 poisoned, 137
 punctured, 136
 united of, 17, 108
- Wounds of abdomen**, 402
 air-passages, 376
 ankle joint, 214

Wounds (continued).

- of aorta, 398
- arteries, 155, 581. *See* Arteries
- completing fracture, 232, 236
- in operation for hernia, 993
- lithotomy, 1093, 1103
- bladder 408
- in lithotomy, 1095
- brain, 354
- bulb of urethra, in lithotomy, 1095, 1103
- cerebral nerves, 855
- cheeks, 370
- diaphragm, 402
- dura mater, 350
- ears, 371
- elbow-joint, 214
- eye, 373
- face, 370
- forehead, 370
- genital organs, 409
- heart, 397
- hip-joint, 213
- intestines, 403
- in operation for hernia, 993
- joints, 211
- by fracture, 233, 236
- knee-joint, 213
- larynx, 376
- lips, 370
- lungs, 390
- ly fractured ribs, 251
- mouth, 374
- nerves, 207
- oesophagus, 376, 380

Wounds (continued).

- of orbit, 372
- palate, 374
- parietal pleura, 37
- pelvic organs, 36
- penis, 369
- pericardium, 397
- pharynx, 374, 38
- rectum in lithotomy, 342
- scalp, 342
- shoulder-joint, 213
- spinal cord, 354
- throat, 375
- thyroid gland, 370
- tongue, 374
- trachea, 376
- urethra, 410
- veins, 154
- vena cava, 399
- wrist-joint, 214
- Wrist, amputation of, 214
- dislocations of, 310
- exposed, 768
- fractures near the, 214
- wounds of, 214
- Wry neck, 823
- apparatus for, 624
- Wutzer's operation for

XANTHINE, 1067
X knee, 337

Zinc, chloride of, in case
Zygoma, fractures of, 24

ERRATA.

- PAGE 2, line 13 from bottom, for "sloughy and intercurrent,"
"sloughy; and intercurrent disease."
" 8, line 4 from bottom, for "Immediate Precautions," read
"parations"
" 25, line 20, for "ground," read "growth"
" 314, line 3 from bottom, for "expressed," read "described."
" 1096, line 2 from bottom, for "shows," read "show"







M31 Erichsen, Sir J.E. 12501
E68 The science and art of
1864 ~~surgery~~

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